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ORGANISMS IN TIME

By THEODORE W. TORREY

Department of Zoology, Indiana University (Contribution No. 279)

"—that all living things are genetically related as members of one great family, one vast, living symplasm, which, though fragmented into individuals in space, is nevertheless absolutely continuous in time—"(W. M. Wheeler, *Social Life Among the Insects*, pp. 3-4.)

INTRODUCTION

WITH considerable justification biology has been accused of lagging far behind the physical sciences in the formulation of broad principles serving to embrace the theoretical results attained from the detailed investigations of its many branches. It is usually argued in defense, of course, that the 'science of life' is not 'ready' for such a synthesis, but this defense has always borne the faint aroma of an alibi. So far there seem to have been few biologists who have indicated a very great willingness even to try. Most have persisted instead in grubbing away mole-fashion to build higher and higher the already mountainous mass of unorganized factual data, deriving ruminative pleasure from the size of the heap and having little concern about the truths that may be buried in its bowels. Now it isn't altogether my intention to argue the question of the readiness of our science for a culling, nor do I intend to present any pet all-solving program or theory, but I do wish to draw attention to what impresses me as a promising lead that is being overlooked by biologists. I refer to a certain obvious and applicable concept, long since appreciated by our contemporaries in the physical sciences that we biologists for the most part have so far failed to incorporate in our own thinking—the concept of time.

It is most surprising how little attention has been paid to the significance of time by biologists. Here is a factor that has played an important part in the development of physical thought, and there is reason to believe its serious consideration would lead to consequences of equal importance in biology. Much of the tardiness on the part of biologists in thinking of organisms in terms of four dimensions seems to be based on a preconceived fear of the unknown or perhaps merely a stubborn literal adherence to Huxley's tenets of objective science. In any event the conception of the 'four dimensional continuum' which makes up a part of the

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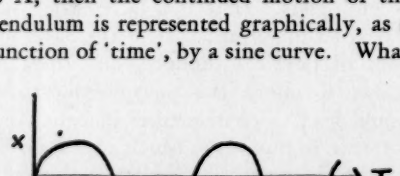
every day thinking processes of the physicist or mathematician is a mental stumbling block over which the biologist trips, and having tripped, despairs. Actually it requires no special kind of intellectual feat to think in terms of four dimensions; the task is only one of logically building upward from a basis of familiar spatial concepts. Such an approach might be somewhat along the lines of the following.

Space is known to us in three different conditions, linear, planal, and three-dimensional, which may be schematized by three straight lines converging at right angles to each other. Or to put it in more tangible form, motion may be limited to a line or a surface or have the whole of space at its disposal. As a crude example of the first possibility, imagine a train moving along a straight stretch of track. A skater gliding freely over the surface of an ice-rink would represent the second condition, and for the third, a bird flying in any direction in the air. For the purpose of analyzing each of these motions a little more in detail and in terms of precise physical conditions rather than by rough analogy, a simple case of linear motion is well demonstrated by a pendulum. If the distance the pendulum moves on each side of the middle position is X, then the continued motion of the pendulum is represented graphically, as a function of 'time', by a sine curve. What



we have here is a succession of linear displacements, X, along a second coordinate, T; thus we see at a single moment, adjacent in space, what in reality is a succession in time. In other words, motion in a single dimension appears as a two-dimensional picture. Exactly the same thing is true for the higher dimensions. Thus motion in a plane such as takes place uniformly in a circle about a vertical axis of T would be a screw line. The next step leads directly to the Einstein-Minkowski conception of all three-dimensional motion as a world line in four-dimensional space. But enough of that. Let us look at the problem from a little different point of view.

Imagine some sort of a creature whose conscious percepts are confined to planal space, just as ours are to three-space, and who has the same difficulty in conceiving of the third dimension as we do of the fourth. If this imaginary creature's consciousness could be compared to the surface of a volume of liquid, then any object that passes through the surface film from either above or below would be sensed as a plane. Suppose, for example, a block of wood marked off in colored squares were slowly lowered into the water, our flat-land creature would perceive a series of two-dimensional objects, each a distinct, separate entity of a characteristic color. Yet we, with our superior powers, know the individual colored squares to be merely parts of a three-dimensional whole. How is Mr. Flatland to know this? Only by assembling the parts into a whole in his own consciousness. In other words, the sensing of this new third dimension to him would consist of the perception of an organized heterogeneity which takes the form of a succession of two-dimensional objects passing in review from the 'future' above the liquid surface through the 'present' of the surface itself into the 'past' below. 'Time' to Mr. Flat-land is our third dimension.

The step upward to a conception of four-space can perhaps be made now with less difficulty, for just as two-space forms are but the boundaries of three-space bodies, so also may three-space forms be regarded as abstractions from four-dimensional bodies.

Now it must immediately be emphasized that time is not to be considered as only another dimension or direction in space. Such a notion is absolutely erroneous, for it is impossible to imagine a new dimension super-imposed upon an already three-dimensional space. The futile attempt to do so represents, I suspect, the secret of the difficulty in which many individuals find themselves when they consider this problem. The thing to be appreciated is that the *fourth dimension only represents the existence of the other three.* This statement requires some amplification.

To speak of the existence of an object is only to express the certitude of finding the object as observed at the moment similar to itself after a given interval, no matter how short that interval. Expressed in a slightly different manner, existence itself implies duration; time becomes the essence of existence, the very condition of the existence of the three dimensions of space. It is not only wrong, then, to conceive of time as an additional dimension in space, but equally wrong to try to compare time and space, for as du Nouy has said, "space has no significance outside of time". One is manifested by and in the other. An example from theoretical physics will perhaps illustrate this more clearly.

Imagine an atom consisting of a central nucleus with a single electron rotating around it. Time will be required for the electron to make the circuit. If, now, one should shorten the history of the atom to a period of time briefer than that required for one rotation of the electron, then clearly the atom has not even been permitted to manifest itself. It will be completely non-existent below the level of a given minimum of time, the minimum required for the rotation of the electron. The atom can exist as a definitive object only in terms of time. *A material object cannot exist instantaneously.*

This somewhat subtle concept of the fusion of time and space generates numerous implications, many of which have been discussed and developed by writers such as Bergson, Pearson, Jeans, Minkowski, and most recently, du Nouy. Many of these implications, however, have no direct bearing on the problem of biology and may be passed over without further reference.

BIOLOGICAL TIME

Proceeding to the question of how this 'time factor' is applied in conjunction with living organisms, we are immediately brought face to face with the almost insurmountable difficulty of attempting to describe or define what we mean by a living organism. Analyzed chemically and physically, organisms reveal no characteristics serving to distinguish them from non-living entities. They are something more than static, three-dimensional objects differentiated by some structural peculiarity or featuring a particular kind of chemical make-up. Such physical and chemical heteronomy is simply not found. We know living things not by how they are built, but by *what they do.* The materials comprising an organism are engaged in a multitude of activities, all directed towards the maintenance of both the individual and the tribe to which it belongs. How these separate activities are integrated into an organized whole is a problem in itself not to be considered here. Rather, the point to be made is that living things are truly organized

events, and events manifest themselves only in time.

To illustrate this further—even in the time required for the writing of this sentence I have become considerably modified as the result of a multitude of physicochemical reactions. The force required to push my pencil across the page has necessitated the expenditure of a certain amount of energy with a corresponding consumption of oxygen and release of carbon dioxide. The associated mental activity has likewise taken its toll of energy; all this in addition to the many reactions concerned merely with the normal maintenance of the body. The heart has continued its regular beat, some blood cells have reached the end of their life span, and others have been born, kidney tubules have removed a bit of waste from the blood, the pancreas has released a volume of digestive fluid and is in the process of manufacturing more, and so on. In the space of a minute or so I have become a changed man. What is any organism other than such a steady stream of physiological activity, a complex of physicochemical reactions in the form of an object that we have all agreed to call a cat or an amoeba or a rose-bush, depending upon the form taken?

Suppose you are sitting here in the room with me as I write. Now and then you look up from the magazine you are reading and note that I am still scribbling away. For an hour or more you are present, and, let us say, in that space of time you look up and observe me half a dozen times and are totally unaware of my presence between times (it's a first rate detective story you are engrossed in). Actually, of course, I have been present all the time, even though you have observed me only at intervals. In other words, your six observations of my existence have been only six cross-sectional intervals totalling no more than a few seconds taken out at random from a continuous existence of an hour. This is a crudely designed situation, but it serves to illustrate a somewhat subtler conception that must be appreciated.

An organism, we have said, is a constantly changing system, presenting at any one instant a physicochemical makeup distinctly different from that of the instant before. When we speak, then, of the organism as an entity, do we have in mind the system as we see it at this particular moment, the moment preceding, or the moment to follow? Obviously at no one of these. Our impression of what we observe at one instant is conditioned by memory of that of the preceding instant and it in turn is carried into the instant following. The pictures overlap or blur, so to speak, and out of the blurring we formulate the whole. The oft-used analogy of the motion picture still serves as the best illustration of this. The series of isolated 'still' pictures printed on the film are projected so rapidly as to create by the overlapping of their impressions upon the retina the illusion of motion. In the same fashion the mere act of observing an organism occupies an interval of time; existence itself, as stated earlier, implies time, i. e. it is impossible to think of something as existing instantaneously. Living things are clearly four dimensional, even more obviously so than non-living things. This static spatial entity that our minds persist in conjuring is nothing more than a three-dimensional abstraction, a cross section as it were, from a four-dimensional whole.

Let us develop the conception a little further. So far we have spoken in terms of a limited number of successive cross sectional pictures over a brief period of time. Yet exactly the same thing holds for longer intervals, in fact for the entire

life span of a given organism. We customarily date the beginning of a new individual from the moment it begins to carry on a relatively independent existence, i. e. from the time it buds off the parent or is born or hatched, and the end with its death. This interval will vary from a few hours to many years, depending upon the organism. Choose man himself. John Doe as a two-year-old infant and a thirty-year-old man are cross sections abstracted from the four-dimensional whole in precisely the same sense as are successive observations of the adult John Doe made over the space of a few moments. True enough the interval of time between cross sections is measured in the first instance in years and in the other in seconds, but this is a difference of degree only and is not significant. The thing is, our sensory equipment is such that we perceive an organism objectively as a succession of cross-sectional pictures which together and only together comprise the whole. (We are not much better off than Mr. Flat-land!) John Doe on the morning of his second birthday is no more and no less the real John Doe than at half past five on the evening of his thirtieth birthday. The true John Doe—the real organism—is that ever changing, nonstatic totality, that stream of physicochemical reactions manifesting itself in changing three spatial form that persists from birth until death.

One may well immediately ask why limit the organism to the hyper-dimensional entity existing between birth and death. The answer to that is, no reason at all; in fact there's every reason for not doing so. The biologist knows full well that the phenomenon of birth (or any corresponding phenomenon such as hatching) is only an incidental event primarily marking the transition of an organism from a dependent to a relatively independent existence without interruption of the ontogenetic process itself. The marsupials illustrate this particularly well.

The opossum embryo, for example, is born in a very incomplete structural condition after a gestation period of a mere thirteen days and thence continues its development for another 50 days or so in the marsupium. Birth of any eutherian mammal at a corresponding stage of development would certainly be considered as being decidedly premature. The 'incidental event' in the case of the marsupials just happens to occur earlier in embryonic life, or shall we say that the site of development is simply shifted from uterus to marsupium. The point is, parturition does not mark the end of one kind of an individual and the beginning of another; as an event it may be shifted before or backwards without significant influence upon the flowing stream of form change. The foetus an hour or a day before birth is thus truly as much a part of the real, complete individual as is the newborn of an hour or a day. Actually there is much less difference between them, i. e. the cross sections are closer together, than between the infant and the man of thirty. The true, whole organism, then, must include all of its embryonic life as well—the anterior boundary of the four-dimensional individual must be pushed forward to the condition of its origin, that is, to the single-celled impregnate ovum. The one conspicuous difference would be found in the much greater rapidity of form change during embryonic life, which of course is only an expression of the greater rapidity with which morphogenetic events proceed and succeed each other.

THE ORGANISMAL CONCEPT

So far in our discussion, we have assumed a very comprehensive view of

living things, looking upon any stage of an organism's ontogenetic or adult history as only a part abstracted from a hyperdimensional whole. Sight must not be lost of the fact, however, that such abstracted parts are of themselves also wholes, albeit wholes of a lower order. Any cross section that one might choose, whether it be a twenty-five somite embryo or thirty-year-old adult, is also a unit, an organized, integrated going concern, it itself made up of parts subsidiary to the whole which in turn is a part of a greater whole. Thus an individual of any historical stage may be analyzed progressively downward into systems, organs, tissues, cells, and cell components which, although they exhibit a certain degree of ontogenetic and adult independence, are entities of a lower order than the whole and bent essentially upon the service of the whole.

In this connection attention should be drawn to the logistic system developed by Woodger (1930) in a study of the relation between embryology and genetics. Woodger conceives of the organism as a system of separate entities, ranging from the lowest cell component to the complete individual, arranged in hierarchial order. Every part is a whole, in a sense, but each is only a part of the whole of the systemic level above it and includes the whole of the level below it. To illustrate, the endoderm of a gastrula is a whole of one level, but only a part of a greater whole, the gastrula itself. Likewise the cells making up the endoderm are parts of the part of the whole, the nucleus of one such cell a part of the part of the part of the whole and so on. Woodger also conceives of a greater whole, the "division hierarchy" which includes the entire ontogenetic history of the organism. A given embryonic stage of development, therefore, becomes a 'short temporal slice' of the division hierarchy. Though clothed in logistic language, Woodger's notions would seem to be essentially comparable to my own.

The analysis of organisms in terms of their parts has long since been carried out with remarkable thoroughness. The structure of organs and systems down to their very minutia is known to us and the manner in which they perform their individual functions is known almost equally well. To the pure mechanist a complete knowledge of the workings of its various parts is all that is necessary to describe the nature and activities of living things. But there has always been the lurking suspicion that an organism is something more than the mere sum total of its individual parts—a suspicion crystallized in times past in the form of various vitalistic interpretations and more recently in conceptions that may collectively be described as organismal. Stripped of the variable trappings with which it has been adorned by many interpreters, the organismal point of view is simply one of recognizing that life is not a property of any particular kind of substance or structure, no matter how complex, but of an *organization* and that this organization is invariably manifested as an organism. There is no life except in this form. We may talk to the freshman of 'living substance', but nobody ever saw protoplasm running around loose. The idea of living substance as distinct from an individual organism is a pure abstraction that has no counterpart in nature. Organisms thus become the fundamental unit of biology and the examination of any of the phenomena that we associate with living things must invariably be made in terms of this unit.

We may well marvel at the beautiful functional integration of the organs and systems making up the multicellular organism and yet have no comprehension of the fundamental unity involved. For that integration is not solely one such as we observe in a smoothly working machine, but rather one wherein all parts are devoted entirely to the benefit and maintenance of the whole. No one knows this better than the physiologist who has

learned that a complete understanding of the working of one part is to be had only in the light of its relations to all other parts. Similarly the psychologist, who is coming to appreciate that the proper interpretation of behavior can be made only in terms of the organism as a unit.

The individual performs not only as a functional unity, but under any and all conditions attempts to maintain as far as possible that essential unity. Witness the phenomenon of regeneration wherein the whole is reconstituted from a remaining part, often a very small part. The thought of regeneration incites the further realization that the activities of the organism are as equally related to the ends of development and reproduction as they are to its every-day performance and maintenance. The essential wholeness of living things is no more clearly marked than during ontogeny.

It has already been emphasized that any embryonic stage is as truly a segment of the real organism as is any post-natal stage, the period of ontogenetic life differing from later periods only in the greater speed of flow of the stream of morphogenesis. It is this very rapidity of form change that brings the underlying wholeness into sharp relief, and it has been the function of the experimental embryologist to take preliminary steps in its analysis. The data from embryology have been assembled in support of the organismal hypothesis by so many writers (cf. reviews of the material by Bertalanffy, Woodger, and Russell) that it will suffice to marshall only a few of the more general experimentally derived conclusions for the purpose of illustration.

The ability of a mutilated organism to restitute the lost parts has already been cited. An analogous situation is found wherein a fragment of a germ, e. g. a half-blastomere, produces out of its own substance parts to which it normally would not have given rise, or otherwise regulates itself so as to produce the whole. Induction phenomena in general likewise emphasize the wholeness of embryonic germs. This is particularly conspicuous in the formation of secondary embryos whose materials are derived partly from the inductor itself and partly out of the surrounding materials. And finally there is that excellent demonstration lodged in the axiom that the development of the part is a function of its situation in the whole which has been an outgrowth of the concept of the embryonic field.

This extremely brief treatment of the organismal point of view has been introduced solely to further emphasize the essential oneness of the individual from egg through adult. But the fertilized ovum actually represents an anterior limit as arbitrary in definition as the newborn infant. The events of fertilization rightly belong in the history of the individual, and pushing still further along, the ovum itself has a complex maturation history which in many forms may actually overlap the initial stages of specific embryonic development. So the boundary is once more moved forward, this time so as to include in the scope of the hyperdimensional individual all of the maturation history of the egg-cell. There you may be willing to establish an anterior space-time limit, but pause momentarily and consider at this point one of biology's best established tenets, the principle of the continuity of life.

THE CONTINUITY OF LIFE

So far as we know life is not being created *de novo* at the present time. Rather, since its inception on the earth's surface no organism has ever arisen save from some preexisting organism, a con-

tinuum no more vividly described than in the eighty-year-old words of Virchow:

"Where a cell exists there must have been a pre-existing cell, just as the animal arises only from an animal and the plant only from a plant. The principle is thus established—that throughout the whole series of living forms, whether entire animal or plant organisms, or their component parts, there rules an eternal law of continuous development." (*Cellular Pathologie*, 1858, p. 25.)

It matters little whether this continuity be maintained by direct fission, as in the case of some of the protozoa, or by more complex means involving the setting aside and transmission of definitive germ plasm. The thing is, the individual as an ovum is inviolably linked with its progenitors and thus represents the initial stage in a *new cycle of the hyperspatial individual* rather than the beginning of an entirely new entity. It follows, then, that these self-same progenitors must be included as an integral part of the whole and their progenitors in turn, and so on right back to the very beginning of life. From such a point of view an individual's phylogenetic history is as truly a part of the real organism as its ontogenetic history. Essentially this same idea lies in the words of Russell (1930, p. 171) who says:

The living thing at any one moment of its history must be regarded as merely a phase of a life-cycle. It is the whole cycle that is the life of the individual, and this cycle is indissolubly linked with previous life cycles—those of its ancestors right back to the dawn of life. This is what we mean by the continuity of life. And the activities of the organism at any stage of its career can be understood only if they are reintegrated in the individual and evolutionary life cycles.

Just how it happens that since the beginning of life new life cycles have exhibited change and divergence in many directions is the problem of evolution itself, and in conjunction with this some of the conclusions derived by Professor A. C. Kinsey from his studies on parasitic Hymenoptera are of interest.

RECAPITULATION AND PHYLOGENY

Kinsey contends that the classic conception of evolution as having progressed by dichotomous branchings from common stems as pictured by phylogenetic trees is fundamentally false. As the fossil connecting links between taxonomic groups are uncovered and the similarities and relationships of present day species are further analyzed, the phylogenetic picture becomes one of continuous chains of species of which only the diverse ends, so to speak, represent higher categories. Descent, therefore, has been linear rather than dichotomous and the higher taxonomic categories are only

"arbitrarily delimited sections of phylogenetically continuous chains of species." (Kinsey, 1937, p. 219.) "The same system of genetics which explains Mendelian races and the origin of species will explain the nature and origin of any higher category, for there are no characters in such categories apart from the characters of the species of which the group is composed. Evolution is never more than a process of change in single genes, rearrangement of gene complexes and aggregations of genes, and the modification of gene frequencies in the development of specific populations." (*op. cit.*, p. 222.)

In these chains there are no real discontinuities, only apparent ones due either to lack of taxonomic data or actual extermination of once existent forms. One can conceive how, if data concerning all organisms past and present were available, they would all assume their correct positions or levels in the phylogenetic succession. Kinsey himself points out that the validity of this interpretation, based as it is on a limited group of insects, can be established only following studies upon a great variety of forms. In any event, his conclusions suggest interesting possibilities.

Is it too far fetched, for example, to

look upon that collection of individuals, which in their variety comprise the species, as an abstraction from the whole, albeit a more comprehensive one, in the same sense that one individual or ontogenetic stage thereof is a cross section of a more limited sort? The individual, the species, the genus, all other taxonomic categories are thus only abstractions of variable degrees, i. e. of successive levels of comprehensiveness. Out of this there can come only one conclusion: all living things, plant and animal, comprise a continuum that is *the* organism. There is only *one organism* and it manifests itself in a multiplicity and succession of forms and complexities. The phylum or the species has no more fundamental significance than has a three-day-old chick embryo or Harrison's 'Stage 23' of *Amblystoma* abstracted from the whole. The phylum and the embryo are merely levels of a different order or degree; or shall we say, subsidiary organisms selected at two extremes from the hierarchy of gradating morphological levels which comprise the whole—*the hierarchy which is the organism.*

It is of great interest to observe how such an historical point of view may further an understanding and to some extent give an answer to the problems of recapitulation and heredity. Briefly, the form and activity of an organism at any one time, i. e. any temporal slice, is related both to its past and to its future. Recapitulatory structures need not be explained on a basis of the past somehow having made a permanent imprint upon the future, nor by any variety of mnemic theory; paeligenetic characters, so-called, may very well be those featuring the anatomy of the individual at that particular cross-sectional stage of its life cycle, to be compared with those characters designated as coenogenetic in the same manner and sense that the general vertebrate features of an adult mammal are to be compared with those which are purely mammalian in character. An organism inherits its form and structure and passes it on to its descendants because its past and future, as well as its present, *are* the organism.

To illustrate with a specific example, take the excretory system which is so commonly employed as a demonstration of the remarkable parallel existing between ontogeny and phylogeny. Every sophomore in zoology can rattle off in the very best parrot-fashion the ontogenetic succession of kidney types and make the usual phylogenetic inferences. Now although all morphologists have not been and are not now in complete agreement, a prevalent opinion holds the pro-, meso-, and metanephros to be merely parts of a single, continuous organ which develop in temporal order from anterior to posterior. Without going into all the morphological evidence, it may be pointed out in favor of this conception that in both their development and final structure there is far less distinction between the three kidneys than appears at first glance.

Comparing the pronephros with the mesonephros, where perhaps the essential relation they bear to each other is less obvious, one finds first of all that the tubules of both organs develop in fundamentally the same fashion from the nephrotomes. Furthermore, the structural characters usually serving to distinguish the type tubules of one from the other are so vaguely defined, or shall we say mutually distributed between the two, in the case of such forms as *Lepidosteus* and *Hypogeophis* that the distinction breaks down entirely. And in the Myxinoids, e.g. *Bdellostoma*, and less clearly in *Petromyzon* and some Amphibia, the history of the tubules shows them without

question to be serially homologous. In addition, the longitudinal drainage duct is here derived throughout its length from the outer ends of the tubules, all of which points further to the general conclusion that fundamentally the pro- and mesonephros represent two portions of an originally continuous and uniform archinephros with an archinephric duct. The general tendency in the higher craniates for the pronephros to precede the mesonephros in both time and space is a secondary acquisition which should not be allowed to obscure the fundamental oneness that now manifests itself in time.

In both structure and development the mesonephros and metanephros are even more alike. The history of the mesonephros itself is indicative of this. Its anterior regions, for example, show a progressive reduction (and assumption of reproductive functions) with a corresponding shift of excretory functions posteriorly. Even in Amphibia and Pisces it is the posterior part of the organ that plays the major excretory rôle. In fact in the Selachii and Teleostei there is a pronounced tendency for the openings of the tubules to shift backwards and combine to form almost a separate organ with a special duct of its own opening at the base of the mesonephric duct proper. This tendency is so marked as to lead some workers to homologize these elements with a metanephros and ureter. It would seem better, however, to employ Kerr's term 'opisthonephros' for such a setup. In any event, the ontogeny of the definitive metanephros of the amniotes shows it to be a structure not essentially different than its precursor in the anamniotes. Meso- and metanephros become in fact merely parts of a single structure manifesting themselves ontogenetically in amniotes at different temporal levels.

Certain experimental evidence is also suggestive of the oneness of the temporally partitioned excretory system. Recently Waddington (1938) has shown that if the posterior elongation of the Wolffian duct of the chick embryo towards the cloaca is mechanically checked, the mesonephros does not properly develop, appearing only as small patches of non-tubular tissue. These results confirm an earlier suggestion by Needham (1931) that an organ which is vestigial in the sense that it has lost its physiological function may be retained because it provides a morphogenetic stimulus which induces the formation of a later evolved structure. This is actually only a restatement of an idea long since introduced by Kleinenberg (1886) than the new can arise only in an organism containing the old, i.e. that it is dependent on the prior existence of the replaced organ. Keeping in mind that the expressions 'new' or 'later evolved' refer only to relatively recent modifications of previously existing structures, we are led directly back to an earlier conclusion that because we are dealing with a continuum, vestigial or recapitulatory structures occur because they comprise a part of the whole and determine its character just as truly as do the final products.

Any other organ or system of organs one might choose seems to be amenable to an interpretation of the same sort. The reduction and modifications of the aortic arches; the phylogenetic and ontogenetic transformation of a pulsating tube progressively into a two-, three-, and four-chambered heart; the progressive erection of the superstructure of the brain upon a fundamental four-ventricle, five-vesicle foundation; the origin and relations of the pharyngeal pouches and arches—these and all others are subject to the same interpretation. The lower levels of development are in both phylogeny and ontogeny earlier temporal slices from the whole, and thus

at the same time the precursors of the higher levels or later temporal slices. So it results that a general parallelism between ontogeny and phylogeny occurs, although this is far from 'recapitulation' in the original literal sense of the word. To paraphrase an earlier statement, a structure in its development presents a form reminiscent of its phylogenetic past because its past (and future) as well as its present *are* the structure.

COMPARATIVE BIOCHEMISTRY

Though from an entirely different point of view, much the same picture of oneness and continuity is obtained from the assembling of the facts of comparative biochemistry. Look first of all at that spatial hierarchy consisting of systems, organs, tissues, cells, and so on down which comprise the individual at any single stage of its history. The inorganic constituents, i.e. the lowest level of organization of the cells, will show a remarkable similarity of composition, suggesting the existence of a determinate ground-plan upon which all living cells are based. At the next higher level, that of small organic molecules, the similarity of chemical composition is still great though some variety now becomes manifest. At the still higher level of the enzymes, the divergence is greater, though close resemblances can still be traced as evidenced by the wide distribution of similar enzymes among not only different tissues but even different individuals. (Witness also the extensive distribution of essentially similar endocrine substances through the whole range of animal forms.) Though the essential biochemical continuity between the higher levels of organization, i.e. the tissues and organs, and the lower is less obvious, yet Needham (1936) has gone far toward marshalling the data supporting the reality of this continuity as well. Acceptance of this opens the door to an interpretation of morphogenesis as a manifestation of change in biochemical configuration. Starting with a fundamental ground plan at the lowest levels of the spatial hierarchy, all subsequent modifications expressed by changes of outward form are both limited and directed to definite pathways, for any conditions that exist at one level must be compatible with and are determined by those conditions at the preexisting level and they in turn determine and limit the conditions at the next higher level. Herein undoubtedly lies the secret of the nature of that whole collection of ontogenetic associations comprising organizer phenomena.

Still less obvious than the chemical continuity of the parts within the individual is that existing between individuals and between taxonomic categories, yet there is evidence of continuity here too. Briefly, we have the comparative series of growth curves obtained by Huxley (1932) which suggest a common plan of animal growth which is, after all, only an expression of community of physicochemical processes. Then there are the long known striking resemblances between the ionic compositions of the blood and tissue fluids of widely different animals. And finally there is that system of interlinked metabolic processes known collectively as the Parnas cycle which has been demonstrated to prevail widely in the muscles of both vertebrates and invertebrates.

True enough only by a considerable extension of such facts of comparative biochemistry can the relations of the various levels of the organismal hierarchy be clearly established, but even this limited information points suggestively to the same principle of continuity already established on morphological grounds. But

to turn to still another aspect of the picture.

Earlier in this discussion it was pointed out how difficult it is to distinguish between the living and the non-living. So long as we are dealing with objects obviously alive like dogs and cats in contrast to objects obviously inanimate such as rocks and water, there is no confusing them, but many entities occupy an intermediate position and are not amenable to pigeon-holing. In fact much fruitless labor has been expended by those who would do so, for they at the same time arbitrarily establish a boundary between the living and the non-living which does not exist.

The imperceptible transition of the one into the other can be appreciated in no better way than by considering how well nigh impossible it is to characterize in precise terms even those things which we know to be alive. All of the qualities that we associate with life, i.e. irritability, metabolism, growth and reproduction, etc., are not invariably manifested by living systems, and conversely any one or several together of these properties may be exhibited by systems which are unquestionably non-living. Comes then the full realization that living things are not featured by any substance, structure, or activity peculiar and exclusive to themselves, but share their properties with the inanimate.

With life thus defying precise definition, as it does, it matters little how we characterize those entities occupying the transitional position between the strictly living and the strictly non-living. The entities in mind are those lying below the limits of microscopic visibility in that 'world of neglected dimensions' between the coarser constituents of cell structure and the molecular structure investigated by the chemist. Such are those disease producing agents known as the filterable viruses and possibly also the bacteriophages. Biologists have long suspected that these agents, exhibiting as they do properties of both the animate and inanimate, represent the connecting link between the two. Evidence amounting almost to verification of this suspicion has recently come in Stanley's successful isolation of a crystalline protein possessing the properties of the tobacco mosaic virus, so it now appears valid to say there truly is no break between the living and the non-living. The one grades imperceptibly into the other.

WHITEHEAD'S PHILOSOPHY OF ORGANISM

The next and final step is that one already taken by Professor A. N. Whitehead. Professor Whitehead has developed a philosophy of organism in a series of important books, notably *Science and the Modern World*, and *Process and Reality*, and these works in turn have been the object of numerous reviews and commentaries, (cf. Agar, 1936 and Emmet, 1932) to all of which one should turn for the argument supporting the following concluding generalizations. This generalized picture of Whitehead's system will at the same time serve as a concluding restatement of the point of view developed in the preceding pages.

Fundamental to an understanding of Whitehead's system is his concept of reality as consisting of process of experience rather than substance. The essence of a thing is not what it is, but what it does, and the doing of something implies an interval of time in which to do it. Now real things are in the main extremely complex and thus are subject to analysis or subdivision, which is to say they are reducible to a collection of ultimate processes. Any one such ultimate process, if it is incapable of further subdivision,

comprises an actual entity. Conversely, then, the final real things of which the universe is composed are actual entities. Just what these ultimate processes are, electronic vibrations or something even simpler, is not important for our purposes. What is important, however, is that reality consists not of substance exhibiting or supporting certain qualities, but is rather an event in experience expressing itself in 'subjective form'.

An actual entity furthermore is not to be conceived of as an isolated, unrelated unit, for it bears a close relation to its contiguous predecessors and in turn influences its successors. In other words, the character (subjective form) of a given entity is determined by its reception into its own constitution (prehension) of the qualities (initial data) of its precursors and it in turn transmits itself to the future.

The general scheme of relatedness by way of which the prehensions of actual entities are bound into a group Whitehead calls the *extensive continuum*, whose most obvious feature is its space-time character. Such a continuum of entities in "the unity of the relatedness constituted by their prehensions of each other" (*Process and Reality*, p. 32) comprises a nexus. The simplest type of nexus consists of a temporal succession or 'strand' of actual entities in the same sense that ontogeny consists of a succession of morphological 'time-slabs.' A nexus, too, is a unity in itself with properties peculiar to itself. This conception of unity for the first time strikes a responsive chord in the minds of biologists, for in it is found the nucleus of the idea underlying all organismal theories, namely that the whole is more than the sum of its parts.

Now it must be appreciated that the simplest nexus is still below the grade of an atom; that actually an atom consists of many strands, i.e. electrons and protons. Atoms in turn are brought together in the form of molecules, the molecules into compounds, and so on through to the most highly evolved living organism. Each higher level of organization is likewise designated as a nexus. In other words, there are many types or degrees of nexūs and, most important, each includes all the nexūs below it. (Cf. Woodger's "division hierarchy.") This does not mean, however, that the character of a nexus of relatively high order consists only of the sum of the characters of those nexūs it prehends. Subjectively there is multiplicity; objectively there is unity and individuality. Thus the gradating nexūs take the form progressively of "electrons, molecules, rocks, and men," each an objective unity but each, too, a part of the whole space-time continuum, *the ultimate nexus which is the universe*.

It is the universe, then, that is *the* organism, and all the nexūs prehended by it are organisms of a gradating subsidiary character. Atoms as well as men are organisms, the one a nexus of a low order and non-living, the other of a high order and living. The difference between living and non-living organisms thus is one of degree only and we can join Whitehead in saying that "Biology is the study of the larger organisms, whereas Physics is the study of the smaller organisms" (*Science and the Modern World*, p. 145).

LIST OF LITERATURE

AGAR, W. E. 1936. Whitehead's philosophy of organism. An introduction for biologists. QUART. REV. BIOL., vol. 11, no. 1, pp. 16–34.

BALDWIN, E. 1937. Rigidification in Phylogeny. Perspectives in Biochemistry. Cambridge Univ. Press.

BAVINK, B. 1932. The Natural Sciences. 4th ed. trans. by H. S. Hatfield. The Century Co.

BERTALANFFY, L. VON. 1933. Modern Theories of Development. Trans. by J. H. Woodger. Oxford Univ. Press.

CARREL, A. 1931. Physiological time. *Science*, vol. 74, no. 1919, pp 618–621.

——. 1935. Man the Unknown. Harper & Bros.

DU NOUY, P. L. 1937. Biological Time. The Macmillan Co.

EMMET, D. M. 1932. Whitehead's Philosophy of Organism. The Macmillan Co.

GOODRICH, E. S. 1930. Studies on the Structure and Development of Vertebrates. Chap. 13, "Excretory organs and genital ducts." The Macmillan Co.

HUXLEY, J. 1932. Problems of Relative Growth. *London*. The Dial Press.

JEANS, J. H. 1930. The Mysterious Universe. Cambridge Univ. Press.

——. 1930. The Universe Around Us. 2nd ed. Cambridge Univ. Press.

KINSEY, A. C. 1936. The origin of higher categories in Cynips. *Ind. Univ. Pub. Sci. Ser.* No. 4.

——. 1937. Supra-specific variation in nature and in classification. *Amer. Nat.*, vol. 71, pp. 206–222.

KLEINENBERG, N. 1886. In *Zeitschr. f. wissen. Zool.*, vol. 44, p. 212. (Quoted from Needham, 1931.)

MCCRADY, E. JR. 1938. The embryology of the opossum. *The Amer. Anat. Mem.* No. 16.

NEEDHAM, J. 1931. Chemical Embryology. Vol. III, p. 1629. Cambridge Univ. Press.

——. 1933. On the dissociability of the fundamental processes in ontogenesis. *Biol. Rev.*, vol. 8, p. 180.

——. 1936. Order and Life. Cambridge Univ. Press.

PIRIE, N. W. 1937. The Meaninglessness of the Terms Life and Living. Perspectives in Biochemistry. Cambridge Univ. Press.

RUSSELL, E. S. 1930. The Interpretation of Development and Heredity. Oxford Univ. Press.

SPEMANN, H. 1938. Embryonic Development and Induction. Yale Univ. Press.

STANLEY, W. M. 1935. Isolation of a crystalline protein possessing the properties of tobacco-mosaic virus. *Science*, vol. 81, no. 2113, pp. 644–645.

TORREY, T. W. 1938. The absorption of colloidal carbon from the body cavity of Ammocoetes. A study of the structure and function of the larval kidneys and blood forming tissues. *Jour. Morph.*, vol. 63, no. 1, pp. 163–179.

WADDINGTON, C. H. 1938. The morphogenetic function of a vestigial organ in the chick. *Jour. Exp. Biol.*, vol. 15, p. 371.

WHITEHEAD, A. N. 1926. Science and the Modern World. Cambridge Univ. Press.

——. 1929. Process and Reality. Cambridge Univ. Press.

WILSON, E. B. 1925. The Cell in Development and Heredity. 3rd ed., Macmillan Co.

WOODGER, J. H. 1929. Biological Principles. Harcourt-Brace & Co.

——. 1930. The "Concept of Organism" and the relation between embryology and genetics. QUART. REV. BIOL., vol. 5, no. 1. Part I, pp. 1–21; Part II, pp. 438–463.

EFFECTS OF FEEDING THYROID SUBSTANCE

By B. AUBREY SCHNEIDER

Department of Biology, School of Hygiene and Public Health of the Johns Hopkins University, Baltimore

PHYSIOLOGICAL ACTIVITY AND CHEMISTRY OF THE THYROID GLAND

ACCORDING to Galen (translation by Daremberg, 1854) all the writers up to his time, including Hippocrates and Plato, described the thyroid body together with the salivary and thymus glands as lubricators of the pharynx, larynx, and trachea. The spongy constitution of these bodies, together with the fact that the upper end of the larynx is entirely closed by the epiglottis while swallowing (thus keeping out all but a very small quantity of liquid) seemed to Galen to be contradictory to the time-honored lubricating function of these glands. The spongy nature of the glands seemed better suited for absorbing purposes than for producing lubricating substances. Then, too, it was puzzling to Galen that if these glands had been created for lubricating the larynx, their product was prevented from entering the very organ it was intended to lubricate.

The thyroid gland was carefully observed by Vesalius (in Ball, 1910), a fact which is attested by its presence in his excellent anatomical drawings. Like many other organs, however, (e.g. the vermiform appendix) it apparently did not seem important enough to receive any discussion as to its function.

So the thyroid was an object of both speculation and controversy, as well as of negative interest, until 1656 when it received its first reasonably accurate description by Thomas Wharton in his *Adenographia*. Wharton's reputation as an anatomist rests principally on his *Adenographia*, the first treatise devoted to a comparative discussion of the glands of the body. Born in 1614, the son of a land owner, Wharton took the degree of doctor of medicine at Oxford, and then practised his profession in London. He was appointed physician to St. Thomas's Hospital in 1659, and was for many years an active and highly esteemed member of the College of Physicians. He died in 1673. In his book, Wharton attempts to explain the term 'gland' and takes the position that secretion is a gland's primary purpose. He gives very detailed descriptions of the anatomy of the glands of the body, and assigns to each of them a group of general functions in the physiology of the organism. The thyroid is described in detail, particular note being made of its great vascularity. The functions of the thyroid, according to Wharton, were (1) to heat the hyoid cartilage which would normally be cold; (2) to lubricate the larynx; and (3) to give rotundity and beauty to the neck. It seems strange that even though Galen, fifteen centuries before, had pointed out the difficulties encountered in explaining the lubricating function of the thyroid, Wharton still held to that view. Today these functions seem fantastic, but with minor variations they were regarded as the essential ones

until Claude Bernard's recognition of internal secretion as opposed to external secretion (1855) shed new light on the true physiological activity of the thyroid gland. It was he who first (1859) recognized and described the thyroid as one of the glands of internal secretion.

The physiologists gleaned much understanding of the thyroid from the physicians whose clinical observations on the pathology of the gland led to more exact knowledge of its functions. Parry (1755–1822) in 1786 left an account of exophthalmic goitre which is so complete and original that it more justly entitles him to the honor of its discovery than either Graves (1835) or Basedow (1840). He said (1825, ii, p. 112):

"... a lump the size of a walnut was perceived on the right side of her neck. This continued to enlarge till ... it occupied both sides of her neck, so as to have reached an enormous size, projecting forwards before the margin of the lower jaw. The part swelled was the thyroid gland. The carotid arteries on each side were greatly distended; the eyes were protuded from their sockets, and the countenance exhibited an appearance of agitation and distress, especially on any muscular exertion, which I have rarely seen equalled. [These observations suggested to Parry (*loc. cit.*, p. 128)]: ... that the thyroid gland, of which no use whatever has hitherto been hinted at by physiologists, is intended in part to serve as a diverticulum in order to avert from the brain a part of the blood, which, urged with too great force by various causes might disorder and destroy the functions of that important organ."

In 1835 Graves gave such an admirable description of exophthalmic goitre that the disease still goes by his name. The description was similar to that of Parry in that the thyroid was enlarged, the heart rate was increased, the face was marked with anxiety and hysteria, and the eyes protruded to such an extent that the lids could not be closed.

The next important treatise on exophthalmic goitre came from Basedow (1840) and it was he who gave the three basic symptoms of the disease, or the *Merseburg Triad*: (1) The enlarged thyroid gland; (2) exophthalmos; and (3) tachycardia.

Shortly after the above observations were made on exophthalmic goitre, several physicians reported a group of symptoms associated with the wasting or absence of the thyroid body. Thus, Curling (1850) was the first to associate cretinism with the absence of the thyroid body. Two cases were cited where the thyroid gland was absent and each case presented characteristics typical of cretinism—the stunted yet plump body, the idiotic expression, the broad face and thick lips and tongue. Fagge (1871) suggested that sporadic cretinism is different from endemic cretinism in that it is not associated with goitre, but rather with a wasting or absence of the thyroid. The histories of Fagge's cases showed a general stunted growth, round head, broad face, thick lips, broad hands and feet, and a deficiency of mental powers. Gull (1874) was the first to call attention to cretinism in adults. This report was based on the observations of five cases of adult cretinism. In all of them the author noticed that the patient became more and more languid, with a general increase in bulk. The face became full and round, the complexion soft and fair, and the tissues under the eyes became loose and folded. The lips became large and purple, the hair flaxen and soft, the whole expression placid, and the hands broad and spade-like. There was much fat over the body and in several cases there were traces of oedema. In these cases the author said the condition was not due to any malady of the internal viscera. He stated that he did not know the exact state of the thyroid gland, though it was evident that it was not enlarged. Ord (1878) described five more cases of adult cretin-

ism, and proposed the term *myxoedema* for the malady. In all cases the thyroid gland was diminished and the characteristics were similar to those noted by Gull. The accompanying oedema in most cases suggested to Ord the term myxoedema, though he had no idea of its cause.

Progress in knowledge of the pathology of the gland received impetus as a result of surgical intervention. The mysterious importance of the thyroid gland was emphasized by Schiff (1856) when the gland was excised with fatal results in the dog. Death did not always occur immediately after complete extirpation, but the animals grew more and more languid, and finally, in many cases, died in tetany.

Kocher was the first to excise the thyroid for goitre (1878) and performed this difficult operation over 2000 times with only 4½ per cent mortality. Later (1883) he published his description of "cachexia strumipriva" which he had found as a sequel to 30 out of his first 100 thyroidectomies. This work, in connection with the pioneer experiments of Schiff and the Reverdins, really inaugurated the physiology and physiological surgery of the ductless glands. Reverdin and Reverdin (1883) found that two or three months after complete ablation of the thyroid, their patients presented characteristics analogous to those of cretins; a condition which they termed "operative myxoedema." These investigators did not have 100 per cent mortality, even when the entire gland was removed. In the light of present knowledge, one realizes that this was possible because, as one of the authors stated, the thyroid membrane was left intact by his new method of operating (hence leaving the parathyroids of which he knew nothing). Death from tetany resulting from complete extirpation of the thyroid in animals seemed to indicate to Schiff (1884) that the thyroid had an important rôle in the nutrition of the central nervous system.

In 1884 Horsley (in Paget, 1919) produced myxoedema in monkeys by excising the thyroid gland. The phenomena which followed thyroidectomy in monkeys were similar to those noted by Schiff working with dogs, and to the Reverdins' 'operative myxoedema.' The reactions of the animals were listed in detail, each factor being compared with a similar factor in myxoedema in man. Thus, the conclusion was reached that myxoedema was practically the same disease as sporadic cretinism; probably identical with Kocher's 'cachexia strumipriva,' and Reverdins' 'operative myxoedema'; and very closely associated with endemic cretinism. Lombard (1883) in summarizing previous work on the physiology of the thyroid, stated, in effect, that the thyroid is of major importance in the normal development of body and intelligence in children, and in its maintenance in adults.

The surgical mistakes which resulted in 'operative myxoedema' soon gave rise to attempts to replace the lost activity of the thyroid gland. With the advent of replacement therapy came further knowledge of the exact function of the gland. A very important note on the possible treatment of myxoedema was published by Schiff (1884). He found that his dogs could be safeguarded against some of the consequences of thyroidectomy by transplantation of a thyroid gland from another animal of the same species. He also made the suggestion that an emulsion, or an extract of the thyroid, may have produced the same result if injected into, or ingested by, the animal. Following the lead of Schiff, Murray (1891) showed that relief from myxoedema symptoms could be maintained by hypodermic injections

of an extract of the sheep thyroid. Fox (1892) found that the symptoms of myxoedema were relieved by the oral administration of thyroid. Ord and White (1893) observed that excess administration of thyroid caused an increase in nitrogen excretion, while Hadden (1882) had already cited examples showing that the nitrogenous excretion of myxoedema patients was abnormally low. Müller (1893) discovered that in exophthalmic goitre (Graves' disease) the nitrogenous metabolism was increased. This led to the important work of Magnus-Levy (1895) which showed that the rate of metabolism is abnormally high in Graves' disease (where the thyroid is hyperactive) and abnormally low in myxoedema. Further studies on the physiological activity of the thyroid have been elaborations of the work of Magnus-Levy, and have supported his discovery of the metabolic regulator activity of the gland. The work of Du Bois (1916) has amply confirmed Magnus-Levy's discovery of the association between thyroid activity and metabolic rate. Aided by the Sage calorimeter in determining total metabolism, Du Bois was able to establish the conclusion that the increase in metabolism associated with exophthalmic goitre is directly proportional to the severity of the clinical symptoms. In general, it may be said that very severe cases of hyperthyroidism show an increase of 75 per cent or more in total metabolism; severe cases, 50 per cent or more; and moderately severe and mild cases less than 50 per cent. In cretinism and myxoedema, the metabolism rate may be 25 to 50 per cent below the normal level. Administration of thyroid raises the metabolism in these conditions, and has a similar, though less consistent, effect on normal men. No other gland extract which has been tried produces such an effect in any significant degree. Except for the activity of the thyroid in relation to the other endocrines, the metabolism regulating function is generally recognized as its fundamental rôle in the physiology of the organism.

Just as the exact rôle of the thyroid in the general physiology of the organism has been known only during the past 50 years, so it is with the significant features of the biochemistry of this gland. The therapeutic value of certain substances, now known to contain iodine, in the treatment of goitre, according to Marine (1927) was known to the Chinese fifteen centuries before Christ. Of these substances, sponge ash was the best known and was widely used in the time of Hippocrates. Dioscorides (first century A.D.) referred to the use of the sponge ash in the treatment of goitre, as did also Galen and Pliny.

It was but a few years after the isolation by Courtois in 1812 and the identification of iodine as an element by Gay-Lussac in 1815, that the element was found to exist in abundance in the sea sponge. Following this lead, Coindet (1820) was able to show that it was the iodine in the time-honored sponge remedy that actually produced recovery from goitre. He administered the iodine to his patients either in a solution of potassium iodide, or in an alcoholic tincture. The dosage began at 1.5 grains of iodine daily, increasing to 3.0 grains after several weeks. Under such treatment his patients showed a a constant diminution in the size of the goitre until at about 8 or 10 weeks from the first dose, the malady had completely disappeared. Almost simultaneously, yet independently, Formey (1823) discovered the same phenomenon, and published a note on the successful treatment of several cases of goitre with iodine.

One would think that the significant findings on the relation of thyroid to

goitre would very soon have led to attempts to show whether or not the thyroid was in any way related to iodine metabolism in the body. However, it remained for Baumann (1896) to show first that iodine in a firm organic combination is a normal constituent of the thyroid gland. He treated the gland substance with 10 per cent sulfuric acid and obtained a brownish powder containing about 9 per cent iodine. He named his newly discovered product iodothyrin.

Further investigations of the chemical nature of the thyroid gland were of slight significance until Kendall (1915) reported the isolation from thyroid of a crystalline compound containing 60 per cent of iodine. The same investigator (1916) showed that his iodine-containing compound was the active constituent of the thyroid gland. Later (1919) Kendall named the crystalline compound thyroxin, and in the same year (1919) Kendall and Osterberg reported that the analysis of thyroxin gave the following percentages: carbon, 22.56; hydrogen, 1.70; oxygen, 8.20; nitrogen, 2.39; and iodine, 65.10. From these percentages, and the molecular weight determination of 586, Kendall's empirical formula for thyroxin turned out to be $C_{11}H_{10}O_3NI_3$.

Harington (1926) showed that Kendall's determination of the empirical formula of thyroxin was erroneous, and on the basis of more elaborate experimentation, found the empirical formula to be $C_{15}H_{11}O_4NI_4$. In the same year (1926) Harington and Barger synthesized thyroxin and proved experimentally that the synthetic product had the same effects as natural thyroxin, i.e. thyroxin extracted from the gland.

THYROID FEEDING OF VERTEBRATES

From the oral administration of thyroid extract in the replacement therapy for myxoedema it was but a slight step to early attempts to produce hyperthyroidism in vertebrate organisms other than man by feeding thyroid extract. Chief among the vertebrates that have been used in studies of hyperthyroidism produced by feeding or injection of thyroid extract are the amphibia, birds, and mammals.

In order to understand the manifold reactions of thyroid feeding and thyroxin injections on the vertebrate organism, it is necessary to review the normal physiological functions of the thyroid in the body. The thyroid occupies a central position among the endocrine glands inasmuch as many important physiological processes are subject to its regulation. Metamorphosis, growth, metabolism, temperament, and volume as well as composition of the blood of the body are directly dependent upon the action of the thyroid. The thyroid effects are produced partly by the direct influence upon the cells of the body, partly by way of the central nervous system, and partly by the effects upon the other organs of internal secretion. In contrast to other endocrine organs, the thyroid, according to our present knowledge, gives rise to only *one* hormone. This does not, however, imply that the principle hitherto regarded as 'the thyroid hormone' may not exist in several chemically distinct, yet interrelated variants. Such an assumption would, in truth, explain the fact that different preparations of the thyroid produce different effects in the same organism. This phenomenon is amply shown in a later section on the thyroid treatment of protozoa. The above assumption would also, to some extent at least, explain the variation in quality of thyroid function of the different vertebrates (also shown in the work on Protozoa and the frog) as well as the variation in response of different vertebrate organ-

isms to the same extract. This latter fact was one of the first phenomena to be observed as a result of thyroid feeding. Hence, the early papers are concerned mostly with the variation in tolerance of vertebrates to the oral administration of the extract.

Cunningham (1898) reported a series of three experiments in hyperthyroidism: (1) subcutaneous injections of thyroid extract in dogs and rabbits; (2) feeding fresh sheep thyroid to chickens, rabbits, dogs, cats, monkeys, and man; and (3) feeding desiccated thyroid extract to chickens, rabbits, dogs, cats, monkeys and man. Toxic symptoms resembling those in exophthalmic goitre in man were produced by the injections, but the conclusion was reached that the effect was not specific for thyroid since the same results were obtained with extracts of other glands. Feeding the desiccated extract produced toxic symptoms also, and the author concluded that the toxic effects were not due to any specific thyroid effect, but to some decomposition product, since the fresh thyroid had no toxic effect. Carlson, Rooks, and McKie (1912) fed thyroid to dogs, foxes, ducks, cats, rats, chickens, pigeons, guinea pigs, rabbits, monkeys and man, and the organisms were tolerant to large doses in the order of the above list. That is, foxes and dogs were most tolerant, and man least. The authors concluded that the former are more tolerant because they are used to a carnivorous and omniverous diet. The toxic effects of thyroid feeding produced loss of weight and gastroenteritis—symptoms which the authors observed were not the same as those of exophthalmic goitre in man. It will be noted, however, that in cases where excess thyroid extract has been fed in the treatment of myxoedema, symptoms similar to those mentioned have been observed. (Zondek, 1935, pp. 198–199).

Amphibians

A great amount of work has been done along the line of experimental hyperthyroidism in the amphibia, especially with reference to the effect of thyroid feeding on metamorphosis. The work of Allen (1916) and Hoskins and Hoskins (1917) on the removal of the thyroid gland in amphibian larvae clearly indicates that this gland is normally indispensible to metamorphosis in these forms. In the above experiments, the thyroid gland was removed soon after its first appearance (5 or 6 mm. total length stage) and hence had never functioned in the tadpole's body. The absence of the thyroid (Allen, 1918; Hoskins and Hoskins, 1919) did not in any manner affect the rate of growth nor the processes of early development up to a certain definite stage. At that particular stage, however, which, of course, varies among genera, and even among species of the same genus, developmental processes abruptly ceased, while normal growth continued. The thyroidectomized tadpoles continued to increase in size, but would not metamorphose further without the administration of some extract of the thyroid. In normal tadpoles, the action of the thyroid then seems to promote metamorphosis and growth simultaneously and at an even pace.

Removal of the thyroid body in frog tadpoles not only inhibited external metamorphosis, but equally influenced the development of the internal organs. Allen (1918) noted that the alimentary tract in the thyroidectomized tadpoles retained its characteristic larval form, and that the brain was hindered in development. Terry (1918) showed that the growth and ossification of the bones of the tadpole after thyroid extirpation were abruptly hindered. In contrast to the above results from the removal of the frog thyroid, is the quite normal develop-

ment of the sex glands, reported by Allen (1918). Swingle (1918) also showed that thyroid feeding did not accelerate the development of the germ cells or sex glands. The point of interest here, as noted by Allen, is that these data confirm once more Weismann's hypothesis of the independence of the germ plasm from the soma.

Further investigations that have been of importance in confirming the above conclusions on the metamorphosis regulator function of the thyroid are the various studies on the effects of thyroid feeding and thyroxin injections in amphibian larvae. The earliest in this field was Gudernatsch (1913a) who found that when thyroid substance was given as food to tadpoles of *Rana temporaria* and *R. esculenta*, it caused a precocious differentiation of the body, but suppressed further growth. The thyroid-fed tadpoles began to metamorphose a few days after the first feeding, and many weeks before the control animals. This same worker (1913b) carried out experiments to determine the least amount of thyroid food necessary to produce acceleration of differentiation, and to determine whether or not the tadpoles could recover from the thyroid shock if later put on other food. When the thyroid was fed for only 24 hours, it caused a hastening of differentiation in the tadpoles. A feeding of three days was enough to give the fastest rate of differentiation; a rate that could not be increased by longer feeding. Recovery from the thyroid influence was extremely rare. Only 10 individuals out of 800 were able to regain normal growth when changed to a normal diet. Morse (1914) concluded that the specific effect of thyroid, discovered by Gudernatsch, in shortening the period of metamorphosis in frog larvae was basically due to iodine, which is associated in some way with the amino-acids composing the complex iodized globulin of the thyroid. This worker also found that inorganic iodine preparations did not produce the accelerating effect. West (1914) fed frog tadpoles daily with commercial (Parke Davis and Co.) sheep thyroid tablets. At the end of 17 days, the thyroid-fed animals had metamorphosed very rapidly and had reached the stage of the development of the fore-limbs, whereas the controls showed no metamorphic changes, and only a slight growth. The experiments of Abderhalden (1915) indicated that tadpoles of *Bufo vulgaris* fed thyroid extract completely metamorphosed in 8 days, while the thymus-fed controls showed only slight evidences of metamorphosis. Of particular interest is the fact that metamorphosis failed to set in or remained imperfect when the animals were fed with thyroid from cases of goitre or Graves' disease (Abderhalden and Schiffmann, 1912).

Romeis (1915) summarizing his studies on the thyroid feeding of *Rana temporaria*, *R. esculenta*, and *Bufo vulgaris* drew conclusions that substantiated the findings of Gudernatsch. He found that the loss of weight of the thyroid-fed tadpoles was due to the loss of water associated with an increased rate of metabolism. The thyroid-fed animals showed an increased rate of metamorphosis and a decreased rate of growth as compared with the muscle-fed controls. Kahn (1916) found that frog tadpoles fed finely minced horse thyroid started metamorphosing much earlier than controls fed on either liver or thymus. A microscopic study showed that the thyroid-fed animals had a smaller thyroid gland, a larger thymus, and a much larger hypophysis than the animals fed on the control diet.

Swingle (1918) fed thyroid to the larvae of *Rana pipiens* and *Rana catesbiana*, and made some interesting observations. The thyroid material (Armour and Co.) was

mixed with wheat flour in the proportion of 3 grams of thyroid to 10 grams of flour, with the addition of enough water to make a thick paste. The paste was dried, and crumbled into the water containing the tadpoles. The thyroid-fed animals ceased to grow after the administration of thyroid, and 5 days after the first feeding they presented characteristics quite different from the controls fed on fresh beef liver. The bodies of the thyroid-fed larvae appeared more slender and the heads more elongated than those of the controls. They also revealed indications of tail involution. Eight days after the first feeding of thyroid, the experimental animals had developed limb buds, and the elongated appearance of the head, previously noted, had increased. The body had become emaciated and pronounced atrophy of the tail was observed. When contrasted with the thyroid-fed larvae, the controls revealed none of the changes enumerated, and had only increased slightly in size during the 8-day period. This same worker (1919) reported that iodine or its inorganic compounds administered to frog tadpoles induced precocious metamorphosis.

The experiments of Kollmann (1919) showed that the effects of thyroid feeding on tadpoles may be quite variable. In summarizing his results, Kollmann called attention to the fact that the age of the tadpole, as well as the state of nutrition must be taken into consideration in discussing the problem. According to Champy (1922) thyroid substance added to water containing frog tadpoles accelerated cell division in some zones and tissues far beyond normal velocities. Miyagawa and Wada (1925), studying the effects of thyroid feeding on tadpoles concluded that the extract inhibits growth and promotes differentiation of the cells of the tadpole's body. Helff (1926) reported some experimental work on the oxygen consumption of thyroid-fed larvae of *Rana pipiens*. A progressive increase of 79 per cent in oxygen consumption per gram of body weight was found to occur in the metamorphosing (thyroid-fed) larvae as compared with the controls. The increased metabolic rate found to exist was regarded by the writer as a secondary phenomenon of metamorphosis, and not to be viewed as a causative factor of that process. Gunthorp (1932) working with three different species of frog tadpoles found that all reacted similarly to thyroid treatment. Extracts of the thyroids of a number of vertebrates were used, and the responses of the tadpoles were recorded as follows: (1) relatively slow development came as a result of feeding calf, raw beef, cooked beef, pig, and flounder thyroids; (2) relatively rapid development came as a result of feeding dog, human, buffalo, and bear thyroids; and (3) development intermediate between the above two extremes came as a result of feeding cat thyroid. Metamorphosis was found to be accelerated in direct proportion to the amount of iodine present in the gland substance, irrespective of the source.

A very thorough report on the effects of thyroid feeding of tadpoles was made by Puckett (1937). Following the procedure of Swingle (noted above), this worker was able to produce precocious metamorphosis in the tadpoles of *Rana sylvatica* by feeding a thyroid-flour paste [3 gm. thyroid (Armour's) to 10 gm. flour]. The controls of this experiment were fed a similar flour paste without the thyroid extract. Metamorphic changes began to appear 3 days after feeding. The first change evident was a reduction in size of body, which lost its rounded tadpole shape, and gradually assumed the slender triangular form characteristic of the frog. Other changes appearing at this time were

the disappearance of the tail fin, the elevation of the eyes, the disappearance of the horny jaws, and a migration of the mouth opening from its original ventral position to a more anterior one. During all this time, there was a rapid growth of the hind limbs, so that by 6 days after thryoid feeding the hind limbs were several millimeters in length, and possessed the typical divisions of the adult limb. At about the sixth day after feeding, the left fore-limb appeared, and at about the eighth, the right fore-limb. Except for an incomplete resorption of the tail, the animal at 9 days was a midget frog with four functional limbs, and capable of existing, for a time at least, out of water. The control animals showed no metamorphic changes during this time except an increase in growth, and differentiation of the hind limbs.

Thyroxin (the isolated hormone of thyroid) in very low concentrations affects the metamorphosis of tadpoles in a manner quite similar to thyroid extract. Romeis (1923) carried out a series of experiments on thyroxin treatment of frog tadpoles. His method consisted principally in immersing the animals in solutions of known concentrations of the hormone for definite periods, and at definite intervals, after which they were placed in normal tap water. He found that the extent and character of the changes produced by thyroxin varied with the concentration of the hormone, the number of treatments, and with the age of the animal at the time of treatment. A definite acceleration in development was produced by concentrations as low as 1:1,000,000,000, if the larvae were kept in the solution during the complete time of their metamorphosis. Gaddum (1927) observed that the most obvious change in frog tadpoles following 24 hours immersion in dilute solutions of thyroxin was a rapid diminution in size. This appeared to be due partly to the hastening of normal processes of metamorphosis and partly to the wasting which is associated with an increase in metabolic rate. Allen (1932) exposed tadpoles of *Bufo halophilus* to thyroxin solutions ranging in concentration from 1:2,000,000 to 1:1,000,000,000 at a stage well prior to the rapid changes of metamorphosis. No response of any portion was observed in solutions of thyroxin of concentrations less than 1:200,000,000, and in that dilution the response was only slight. The different parts studied were arranged in order of responsiveness to lower concentrations of thyroxin as follows: (1) alimentary tract; (2) limb-buds; (3) changes in the color of the gall bladder, tongue growth, and loss of horny jaw; and (4) reduction in the length of the tail, and reduction in the length of the body. The speed of response was in proportion to the concentration of the thyroxin used up to a certain maximum limit, beyond which greater concentrations did not give greater rate of development. Allen concluded that the influence of thyroxin is proportional to the age of the tadpole, being slight in the tail-bud stage, and becoming greater in the 20 mm. total length stage. Alphonse and Baumann (1935) confirmed the conclusions of Romeis and Allen, and stated that thyroxin accelerates metamorphosis in batrachian tadpoles in proportion to the age of the tadpole, the dosage, and the time of exposure to the hormone.

Studies on thyroid feeding of the axolotl, an amphibian which normally lives its entire life in the larval stage, show the remarkable power of the gland substance in inducing metamorphosis. Huxley (1920) was the first to discover that the axolotl will metamorphose as a result of thyroid feeding. He used two young (6 to 12 months old) specimens for

his experiment, and kept them in a tank of water at an average temperature of 15°–16°C. They were fed on ox thyroid, at first three times, and later twice, a week. Within two weeks after the first feeding of thyroid, the axolotls presented distinct alterations in color, and a beginning of the resorption of gills and fins. Within three weeks metamorphosis had been completed. The animals climbed out of the water, able to walk quite well. The skin was as dry as that of any terrestrial salamander.

According to Giacomini (1926) fresh beef thyroid given orally stimulates complete metamorphosis in axolotls from one month upward in age. In adults over two years of age, this worker obtained metamorphosis with a minimum dose of 0.2 to 0.1 gm. of fresh beef thyroid given in single doses. Bělehrádek and Huxley (1927) found significant increases in metabolic rates (oxygen consumption) during metamorphosis of axolotls (larval *Amblystoma tigrinum*) induced by thyroid feeding. In a very thorough study of the metamorphosis of the axolotl Lipchina (1929) noted that the rate of metamorphosis is directly proportional to the concentration of the thyroid extract; but found no concentration capable of producing the complete change in less than 25 days. The rate of metamorphosis had no apparent relation to pigmentation or sex of the animals, but was related to age. The most rapid rate was observed in animals about 6 months old, while the slowest rate occurred in adults. Ingram (1929) demonstrated that the subcutaneous implantation of iodine produced complete metamorphosis in the Colorado axolotl. Balthasart (1932), studying the effects of thyroid feeding and thyroxin injections on the axolotl, concluded that the duration of metamorphosis was inversely proportional to the percentage of iodine in the extract. This worker also believed that iodine is the active agent in the hormone, and that in order for it to act, the iodine must be associated with an organic substance which renders it assimilable without interfering with its action.

The evidence appears conclusive that thyroid feeding of amphibians results in an acceleration of cell division and differentiation in various regions of the body, and in an acceleration of normal metamorphosis. This is merely an accentuation of the normal rôle of the thyroid in the metamorphosis of these animals. Abundant evidence also indicates that thyroid feeding causes complete metamorphosis in the axolotl, a form which normally does not metamorphose. These reactions are independent of sex, but are directly related to the age of the organism, the concentration of the extract, and the time of exposure to the hormone.

Birds

The normal action of the thyroid in the physiology of birds has been adequately demonstrated by Schwarz (1930) in his studies on hypofunction, transplantation, and extirpation of the gland in fowls. His first observation was that the size of the gland was not related in any way to the sex of the fowl. In two hens where hypofunction was discovered, feather development was greatly retarded. This, he held, was a confirmation of the theory that thyroid function is responsible for the velocity of feather growth. In his transplantation experiments, this investigator grafted half of the thyroid body from several types of fowls three-and-a-half months of age into Plymouth Rocks of the same age. In most instances the transplanted tissue underwent necrosis, and was completely resorbed within 20 days. Only on several occasions did a

small amount of the tissue remain to grow and become active. The excess of thyroid products by resorption did not affect the weight of the fowls, but caused a definite darkening of the feathers. There was also an increase in body temperature of the experimental animals as compared with the controls, but the author concluded that much more investigation of the question was necessary before any definite conclusions could be made on this point. Thyroidectomy in cocks and hens resulted in a retardation of growth, a diminution in body weight, and distinct changes in the structure of the feathers. The feathers of the thyroidectomized cock were narrow and pointed, but displayed no change in pattern. The sex of the fowl was not impaired by the absence of the thyroid gland. The hen decreased in weight, and at 7 months after thyroidectomy showed extreme anemia. At 10 months she died. The few feathers that had developed after removal of the gland were of a type intermediate between the two sexes. They were somewhat narrow and pointed, a few approaching the male type. From these observations it appeared to Schwarz that pigmentation and growth of feathers in fowls are fairly dependent upon metabolic rate. Increased thyroid function causes increased pigmentation up to a point where metabolism concerns the oxidation of melanin, at which time depigmentation occurs. Hyperfunction of the thyroid causes an increase in the growth of feathers; hypofunction causes retardation in feather development. The form of the feather is held to be more clearly associated with the sex of the fowl, than to the thyroid. Parkes and Selye (1937) made a further contribution to our knowledge of thyroid activity in fowls by observing the effects resulting from thyroidectomy in several breeds of chickens. The feathers which grew during hypothyroidism in both sexes were elongated, and showed a loss of barbules leading to fringing. Deposition of black pigment was hindered in Brown Leghorns and Silver Dorkings, but was increased in Anconas.

Landauer (1929) reported a morphological and histological study of a dwarf Rhode Island Red pullet. The plumage of this bird was rugged, the skin and feathers were unusually dry. The beak and tongue were grossly deformed and the eyes had puffy patches around them resembling oedema. All the bones of the body showed a retardation in development, and the marrow in many had degenerated. The skull showed striking brachycephaly. The thyroid in this bird was enlarged, and the greater part of the gland consisted of a plastic tissue without colloid. It was suggested that the dwarfism of this chicken was analogous to human myxoedema infantilis. The report also included measurements of five other specimens revealing the same type of dwarfism. These observations show in a clear-cut manner that the normal function of the thyroid is necessary in the development of the skeleton as well as of plumage in the domestic fowl.

Riddle (1928) has shown the existence of at least four "small thyroid" and four "large thyroid" strains of pigeons. The fact that these strains breed true over numerous successive generations is ample evidence that genetic factors for thyroid size do exist. If the size of the gland gives any indication of the quality of its function, it is easy to see that the normal action of the thyroid will vary among strains of the same species. In like manner the oral administration of thyroid will produce a variety of effects among different strains. With these facts in mind, it will be somewhat easier to understand the discrepancies and disagreements

in the studies on experimental hyperthyroidism in birds, now to be discussed.

Experimental hyperthyroidism by feeding or injecting thyroid extract in birds has received the attention of a great number of workers during the past 15 years. Among the most common results of thyroid feeding in fowls are excessive moulting and depigmentation of regenerated feathers. B. Zavadovski (1925) and M. Zavadovsky (1925) in their experiments with fowls, discovered that large doses of thyroid caused a marked loss of feathers, and that the lost feathers were replaced by others which were completely colorless or white in varying degrees depending on the dosage. From this they concluded that the thyroid gland plays a specific rôle in the regulation of the growth and moulting of feathers, and in their pigmentation. Sainton and Peynet (1926) confirmed the observations of Zavadovsky and noted that the administration of thyroid to an adult black hen resulted in the whitening and falling out of the feathers in certain areas. Zawadovsky (1926), in confirming his earlier work on moulting, regeneration and depigmentation of plumage noted that single doses of extract were effective, and that equal success may be obtained from the feeding of sheep, oxen, and horse thyroid. Kendall's thyroxin produced the same result, except that it was 500 to 1,000 times more effective. Control fowls fed with muscle or suprarenals showed no effect even when fed with extremely large doses. Injections of organic iodine (in Lujol's solution) or implantations under the skin in crystal form caused only slight changes. Giacomini and Taibell (1927a and 1927c) reported a moderate partial shedding of plumage in fowls consequent to thyroid feeding. Cole and Hutt (1928) reported that raw and desiccated thyroid fed to male and female fowls caused moulting, but they observed no depigmentation of new feathers as others had reported. These workers found that desiccated extract affected feather growth more than raw thyroid. Zawadovsky and Titajév (1928), in further confirmation of Zavadovsky's earlier work, found that thyroxin injected into fowls caused depigmentation of the plumage and moulting. Crystalline iodine caused a slight depigmentation but no moulting, while injections of iodotyrosine and tryptophane with iodine caused but a feeble depigmentation and moulting. Martin (1929) found that thyroid feeding was followed by a rapid moult and depigmentation of new feathers. A study by Zavadovsky and Lipchina (1929) showed that the addition of thyroid extract to a seed diet of hens caused an increase in the growth of feathers, rapid moulting, depigmentation of new feathers, and a redistribution of pigment in the neck feathers. Horning and Torrey (1923) found that when Brown Leghorn chicks from the age of two weeks were fed dried thyroid daily, the development of adult plumage, both as to form and color, was delayed. The general color of the birds at seven months was darker than normal, because of an increase in black pigment in the hackle, shoulder, back and saddle feathers. The brilliant red, characteristic of the normal hackles, back and saddle feathers, was poorly developed or lacking and its place was taken for the most part by yellow. The color change was associated with a structural change, the increase in width of the dark central stripe being accompanied by an increase in number, and a change in distribution of the barbules on the back.

The work of Domm (1929) on the thyroid feeding of Brown Leghorn fowls is in complete agreement with that of Horning and Torrey. In this study,

Brown Leghorn cocks were fed Armour's powdered desiccated thyroid in dosages which started at 400 mg. per fowl on alternate days, and were gradually increased until at the end of seven months each fowl received 750 mg. daily. The first effects observed were modifications in the color and form of new feathers on the hackle, back, saddle and wing-bow. These feathers, which are normally brilliantly colored in shades of red and yellow, were replaced by others which were almost entirely black. The hackle and saddle feathers were shorter than normal and revealed broadened rounded tips. All of the thyroid-fed birds revealed accelerated replacement of feathers. Křiženecký and Podhradský (1927) had shown that pure bred male and female fowls hyperthyroidized by thyroid feeding were accelerated in moulting and in feather growth. Partial albinism was reported as a result of thyroid treatment; this character, however, lasted only while the extract was being fed. No changes in feathers were observed as a result of thymus feeding. Gericke (1934) found that desiccated thyroid in large doses (1 to 1.5 gm. per kilogram body weight) produced white feathers in females and reddish feathers in the males of Australorp fowls. Capons fed 0.5 gm. to 1 gm. per kilogram moulted profusely and the new feathers developed much quicker than in the controls. The author suggested that thyroid feeding might be employed in bringing about uniform moulting in laying hens, and in encouraging feather growth in young stock.

Sainton and Simonnet (1930) demonstrated that the thyroid was the only endocrine organ extract which would cause a loss of feathers, blanching, and a rapid regeneration of feathers in the fowl. The above modifications were obtained with doses as small as 0.10–0.30 gm. daily. Ingestion of normal thyroid in a total amount of 6.5 gm. caused a blanching of feathers within 6 days. Ingestion of thyroid from simple goitre produced no effect, even when fed in dosages totaling 33.5 gm. Ingestion of thyroid from exophthalmic goitre produced blanching in the same manner and time as with normal thyroid. These writers concluded that some factor other than iodine content was responsible for the effect, inasmuch as the iodine percentages were made identical in the latter two experiments.

Later (1931) these workers performed an experiment in which a cock and two hens were fed tablets containing 30 centigrams of thyroid extract "délipoïde de Byla", at first one a day, and later one every other day. These doses were chosen because they appeared not to cause any harmful effects in the animals during the experimentation. In one hen depigmentation was observed on the fifteenth day after feeding, in the other 60 days after feeding, and in the cock, 50 days after feeding. Egg laying and fecundity were not affected by hyperthyroidism, nor was the volume or general constitution of the egg changed. Five of these eggs were hatched by a normal hen, and five chicks developed normally, although their growth in weight showed a slight acceleration over the controls. Several days after hatching, these chicks, *without themselves having received thyroid treatment*, showed a definite blanching of feathers on the wings and neck. The blanched feathers became permanently established at three months, and were in many respects similar to the modifications noted in the parents as a result of thyroid treatment. These facts indicated to these writers that the phaenotypic character acquired by hyperthyroidism is hereditarily transmissible. Whether the modifications which were passed on were due to the

thyroid effects on the egg, or to some other mechanism, the authors could not say.

Another interesting result of thyroid feeding of fowls is the alteration of the secondary sexual type of plumage to the female type that has been observed by several investigators. Torrey and Horning (1922) found that Rhode Island Red, White Leghorn, and Golden Sebright male fowls fed thyroid developed female feathering in 10 to 15 weeks. The work of Cole and Reid (1924) also indicated that male fowls fed thyroid extract developed feathers of a definitely female type. They noted further that iodine and its compounds did not produce such an effect. Torrey and Horning (1925) substantiated the above conclusions by further investigation, and pointed out that the active element in thyroid extract does not act through the thyroid gland of the fowl, but directly affects the division of cells in the feather germ. The work of Brambell (1926) also indicated that thyroid fed to young chicks caused hen feathering in cocks—a phenomenon which the author believed not to be traceable to the gonads. To determine whether hen feathering after moult is related to a particular sex Giacomini and Taibell (1927b) experimented with males and females of Padun and Arno Valley fowls. Besides the bleaching of feathers, modification in pattern occurred in about the same degree in the two sexes. Not only was there a feminization of male feathers, but also a change in the pattern in both sexes. Hence the conclusion was drawn that thyroid affects the morphogenesis of feathers independent of sex. Another paper (1927d) by these experimenters confirmed their earlier finding that the pattern of new feathers grown after moult caused by thyroid feeding was independent of the gonads. Cole and Hutt (1928) reported that the color and pattern of the feathers in male birds of Hamburg, Barred Rock, and Silver Wyandotte were changed to female patterns subsequent to thyroid feeding. The most interesting changes were observed in the Silver Wyandotte male receiving desiccated thyroid. This bird grew female feathers on the neck, wing-bow and saddle. The neck feathers tended toward solid black rather than the typical black feather with white lacing. On the wing-bow, however, where the male feathers had been white with a black base, there were produced feathers entirely female both in structure and pattern, i.e., white with black lacing. Similarly on the saddle, the new feathers were white with black lacing, whereas those of a normal male are black with a white margin.

Podhradský (1930) found that thyroid feeding of castrated roosters produced changes in the typically male feathering tending toward hen feathering. The most notable changes were those related to color intensification, width, and length of feathers. The action of the thyroid in feather development appeared to be complementary to that of the testes, though independent from it. Perfect feathering according to this investigator, is due to the hormone activity of both the testis and the thyroid gland.

The work of Brambell (1926) indicated that thyroid extract fed to young chicks produced a soft, loose plumage, lighter in color than that of the controls. Zawadovsky (1926) found that the regenerated feathers following a rapid moult caused by thyroid feeding were smoother and more tender than the original plumage. He suggested that a practical application of this work might be found in the fact that more feathers of a softer and smoother texture might be obtained with an increase in number of moults per year. Martin (1929) observed, in his

thyroid-fed chickens, a change in texture of the plumage from the normal to a silky quality. Champy and Morita (1929) found that young chicks treated with very small doses of thyroid showed changes in certain groups of feathers. Those of the back, neck, tail and breast presented characters of growth and color closely resembling the adult type.

Effects other than those related to the plumage have also been reported as the result of feeding thyroid to fowls. Sainton and Peynet (1926) reported a rapid loss of weight, a cessation of egg laying, a rise in temperature, increased excitability, and a diminution in volume and a paling of the comb following thyroid feeding. The effect of thyroid feeding on egg laying in fowls was reported by Giacomini and Taibell (1927a). They found that large quantities of thyroid fed over a short period of time to a pure strain of White Leghorn hens resulted in a prompt and complete cessation of egg laying; followed, after a month, by resumption and cessation again in the normal inactive period. The same total amount of thyroid fed in smaller doses over a longer period of time did not affect egg laying during the regular period of egg production, but decreased the length of the period of inactivity. In the same year (1927c) these workers confirmed their work concerning egg laying, and demonstrated further that when thyroid was fed from an early age, egg laying was retarded in association with the slowing of body growth and sexual maturity. Cole and Hutt (1928) reported that raw and desiccated thyroid fed to male and female fowls did not in any way affect egg laying or body weight. The authors concluded that their negative findings concerning weight and egg laying were due to the relatively small dose (59 mg. daily per pound of live weight) of the extract fed. Zawadowsky, Liptschina, and Radsiwon (1928) presented data confirming the results of Giacomini and Taibell; namely that large single doses (1–2 gm. daily) of thyroid gland fed to hens abruptly stop egg laying. Small doses (0.01 to 0.05 gm. daily), however, increased the egg production of hens that were originally poor layers. Here the statistics indicate that the number of observations was small, and the egg-laying data were variable, so that much more careful experimentation and observation is necessary if the work is to have any particular critical value. Crew (1925) had previously shown that small doses of thyroid fed over a long period of time caused a general rejuvenation in old fowls, and a consequent improvement in the laying power of hens. Asmundson and Pinsky (1935) found that when desiccated thyroid extract was fed to laying hens in such amounts as to supply about 1.0 mg. of thyroid per 1,750 grams of body weight, the weight of the yolk was reduced. There was no effect on the amount of albumen secreted, while there was a significant increase in the amount of shell. The rate of growth of the ovum was reduced by thyroid feeding. The weight of the bird was reduced in every case where desiccated thyroid was fed.

Of particular interest is the fact that birds offer a very high resistance to the thyroid hormone. The work of Martin (1929) on the effect of excessive dosages of thyroid on the domestic fowl showed that single doses (8–30 gm.) of desiccated thyroid, although producing physiological shock, are not lethal to hens. Doses of 30–35 gms. were lethal to two of three capons, but cockerels withstood doses as large as 35 gms. Martin found further that large doses of thyroid produced a loss of weight and a depression in body temperature, especially in capons. A loss of

weight varying from 0.007 percent to 0.08 percent of the total body weight was observed 48 hours after feeding. This loss, however, was made up, so that by the end of 31 days the thyroid treated had gained approximately the same weight as had the controls. The largest drop in temperature was noted also immediately following thyroid treatment, but here the data present enormous variations and hence cannot be analyzed qualitatively. The conclusion was reached that the capons were more susceptible to the thyroid effects probably because of the lack of compensatory hormones from the testes.

Several birds other than the domestic fowl have been used for studies in experimental hyperthyroidism. In nearly all cases the results are similar to those obtained in thyroid feeding of chickens. Zawadovsky (1926) confirmed his earlier work on moulting, regeneration, and depigmentation of plumage by thyroid feeding of fowls, and noted further that similar moulting can be induced in the pigeon, daw, bullfinch, starling, duck, goose, and peacock. The work of Occhipinti (1927) on the quail showed that thyroid feeding of the male causes loss of weight and loss of feathers on the back. The lost feathers were replaced by others of a rougher texture and a duller color, and in less than two months, male birds developed female feathering. The author believed that the effect of thyroid feeding on plumage is secondary, in the sense that the thyroid stimulated the suprarenals and that it is the secretion of those glands that directly affects plumage. Zawadowsky and Rochlin (1927) found that thyroid extract caused very heavy moulting in the partridge and kestrel, and moderate moulting in the screech-owl, bullfinch and jay. None of these showed any depigmentation of the new feathers. The common crow, however, which moulted only slightly, grew new feathers lacking in pigmentation. From these observations the authors suggest that there are two independent ptilosal effects of thyroid on birds—moulting and depigmentation. A study by Larionov (1930) indicated that the feeding of 10 to 20 mgm. of powdered thyroid in water to bullfinches accelerated the rate of regeneration of feathers of the upper wing coverts, the old feathers having been plucked at the start of the experiment. This acceleration was most marked (approximately 20 percent) in a series of six birds fed 20 mgm. daily, and was observed in comparison with both controls fed powdered muscle, and with normal regeneration of feathers in the experimental birds prior to treatment.

Another study was made by Larionov (1931) on the differential effect of size of dose and time of administration of powdered thyroid by mouth on the speed of regeneration of feathers in the bullfinch. The minimal dose giving any noticeable increase in speed of regeneration compared with that of controls fed powdered muscle was 10 mgm. No effect was observed with 3 mgm. and the maximum effect came with 20 mgm. If feeding was delayed 3, 6, 10, or 15 days from the time of plucking, there was a comparable delay in the beginning of acceleration of feather development. The 10- and 15-day delay groups showed no acceleration. From these observations, Larionov suggested that the thyroid exerts its action only during the first stages of feather development.

Miller (1935) experimenting with thyroxin injections into deplumed and castrated male and female sparrows found that the regenerated plumage was modified in all, but that the general effects were greatest in the castrated birds. The

seasonal sex cycle of the male, as indicated by bill color, was accelerated by thyroxin injections. Hardesty (1935) reported that thyroxin injections in doses of 4 mgm. or more produced general moulting in the guinea fowl, with the regenerated feathers appearing sooner than normal. The color and pattern as well as the structure of the regenerated feathers were changed. Raspopova (1930) found that moulting in geese could not be induced in the spring when the animals were fed as much as 40–50 gms. of thyroid extract. When the dosage of 100 gms. was fed, or when an injection of 50 mgm. of thyroxin was made, a heavy moult resulted. The regenerated feathers after thyroid moult showed an increase in the amount of down. Thyroid extract fed in the fall (50 gm.) caused a complete moult and a considerable increase in down. Injections of 30 mgm. thyroxine caused the same effect. The evidence indicates that thyroid is more effective in producing a moult after the regular moulting season, than during the period of normal shedding.

From the above studies of hyperthyroidism in birds, several generalizations can evidently be made. Thyroid feeding or thyroxin injections in birds result in (1) moulting; (2) acceleration and depigmentation of the regenerated feathers; and (3) changes in pattern and structure of the regenerated feathers. These effects seem to be independent of the gonads and of the thyroid gland of the bird, but result from changes in the feather germ itself. The effect of thyroid feeding on body weight and egg laying is apparently in some degree proportional to the quantity of the gland substance fed.

Mammals

As has been stated previously, the thyroid is fundamentally associated with metabolism, growth, metamorphosis, temperament and composition, as well as volume of the blood in the vertebrate organism. This generalization is amply confirmed by the experimental work on thyroid physiology in mammals. The consequences of extirpation and hypofunction of the gland, and the effects of thyroid feeding and hyperfunction have been the two important phases of the subject to receive intensive study.

Hammett (1923) has shown that when the thyroid is absent, either by developmental aberration as in cretinism, or by design as in experimental extirpation, growth is retarded. Experimental ablation of the thyroid in white rats by the same author (1927a, b) showed that the growth of the heart, lungs, liver, kidney, and spleen was retarded as a result of inadequate thyroid action. Fishburne and Cunningham (1938) observed the same retardation in total growth as a result of thyroidectomy in the white rat. Binswanger (1936) observed that complete ablation of the thyroid in dogs at an early age caused a marked retardation in total growth, and in bone development.

Simpson (1924a and b) observed the same phenomenon in experiments with sheep and goats. Part of this work was based on 16 pairs of twin lambs; one of each pair was thyroidectomized, and the other used as a control. When the operation was performed two or three weeks after birth, marked stunting resulted. In most cases the controls attained a weight of three times that of the experimentals. When thyroidectomy was delayed until the third or fourth month, the retardation in growth was only slight. Essentially the same results were obtained with several pairs of kids. These observations led to the conclusion that conditions comparable to myxoedema can be induced by thyroidectomy in the sheep and goat.

A histological study of the skeletal muscles of the sheep following early thyroidectomy was made by Simpson (1927). The striking results of this study were that normal development in the cytoplasm was prevented, and that the muscle cells resembled those seen normally in very young animals.

A thorough study of the rôle of the thyroid in growth and skeletal maturation in sheep was made by Todd, Wharton, and Todd (1938). The observations were based on five pairs of twin sheep, one of each pair being thyroidectomized in early life (1–5 months), the other serving as a control. Thyroidectomy in early life caused a deficient growth and modelling of the epiphysis, so that when ossification was as fully completed as it would ever be in the defective animals, the epiphysis lacked character, and was inadequate to cap the growing end of the shaft. This inadequacy was particularly evident in the epiphysis of the lower limb bones. There was also a deficiency in growth of the long-bone shafts. The duration of growth was not extended to compensate for the deficiency, but the velocity of growth was diminished so that the finished product was not as perfect as in the controls. This disturbance in growth resulted in producing sheep which had the skeletal proportions of unimproved wild type of animals, having little meat or wool value. Kunde (1926a, b) and Kunde and Williams (1926) found that rabbits and rats after thyroidectomy developed a condition similar to rickets, although they were fed an adequate diet. Xerophthalmia and the lesions of pellagra appeared in the thyroidectomized animals on a diet adequate for controls. Thyroidectomized animals carried through the growth period by thyroid treatment, which was then stopped, developed progressive paralysis starting in the hind quarters. At autopsy, the animals paralyzed in this manner showed lesions in the spinal cord.

It is beyond all doubt, then, that the normal function of the thyroid is absolutely essential in the early growth and development of mammals. Removal of the thyroid at an early age always results in a stunted individual that is biologically inferior both anatomically and physiologically to the common herd of normal animals. Such stunted individuals, however, can be brought back to a normal state of growth by the administration of some extract of the thyroid gland (Hammett, 1929). Complete recovery by thyroid medication can be obtained only when the deprivation has not permanently impaired the normal physiological processes of growth. An interesting study on the effect of thyroid treatment on the mental and physical growth of cretinous infants was reported by Gesell, Amatruda and Culotta (1936). It was observed that the effects of thyroid substance on the cretinous infant are of three kinds: metabolic, somatic, and neurodevelopmental. An increase in metabolic rate was the most immediate and general effect of the treatment. There was a marked physical improvement in all cases, and in some cases the patients became almost normal. It was found that the final influence of thyroid therapy is contingent not so much on the age of the child, or maturity status at the time of diagnosis, as on the residual physiological capacity and latent growth potency of the neuroendocrine system. Thyroid therapy cannot bring about normality if there has been a fundamental impairment of that system, either hereditary or developmental.

From the above facts on thyroid therapy, as well as from a priori considerations, it is evident that the administra-

tion of thyroid in some form or other to normal animals is a valid method of producing effects similar to those in hyperthyroidism. According to Hammett (1924) such an increase in thyroid activity in an initially normal animal may result in either an acceleration or a retardation in growth processes; the specific effect being entirely dependent upon the size of the dosage. If the dosage is such that anabolism can keep ahead of katabolism, there will be an acceleration in growth. If, on the other hand, the dosage is such that katabolism is predominant, there will be a retardation in growth. With these facts in mind, the apparent inconsistencies in the following studies are clarified.

Gudernatsch (1915) found that thyroid-fed rats did not in a given time reach the length or weight of normal rats. Hewitt (1919) reported that 0.1 gm. or more of fresh thyroid administered daily to adult male white rats produces hypertrophy of the heart, liver, spleen, kidney, and suprarenals, and a diminution in the size of the thyroid gland. Durrant (1928) made a study of the effects of thyroid feeding on guinea pigs, using animals from 7 litters, ranging in age from 12 days to 3 months. The dosage was ¼ grain of desiccated thyroid (Armour's) on alternate days for some, and the same amount once a week for others. All the thyroid-fed animals grew less rapidly than their litter controls, and those given the heavier dosage died in from 12 to 20 days. The thyroid-fed showed an increase in weight of 12 percent to 480 percent; the controls, an increase of 75 percent to 675 percent. Robertson (1928) reported that desiccated thyroid tissue administered continuously to white mice in dosages corresponding to 19 mgm. of fresh thyroid per mouse per day accelerated early growth without modifying the maximum weight which the animals eventually attained. Mean life duration was found to be shortened by thyroid feeding of the above dosage to 15 weeks or 7 percent of the normal life span.

Several physiological phenomena other than metabolism and growth have been shown to be directly affected by thyroid activity. Thus, heart rate, blood composition and blood volume are regulated to a great extent by the thyroid. Fishburne and Cunningham (1938) studying replacement therapy in thyroidectomized rats, found that after removal of the gland the heart rate showed a slight increase (probably due to operation effects) followed by a slowing for several days until it reached a new basal rate of 50 to 100 beats per minute as compared with 300 beats per minute in normal rats. By feeding small amounts of thyroid extract, the heart rate could be raised from the new level to normal or even past the normal level. With thyroxin injections it was found that 0.04 mg. of the crystalline hormone per day raised the heart rate to the normal 300 beats per minute. It was concluded that this amount of thyroxin (0.04) per day is secreted in the rat to maintain a constant heart rate of 300 beats per minute.

Wislicki (1929) reported that in Basedow's disease, where there is an increase in basal metabolism, there is a definite increase in the volume of blood in the body. In contrast, the opposite was found to be the case in myxoedema. In myxoedema, after thyroid medication, the blood volume increases as much as one-and-a-half times that of the original amount.

Blalock and Harrison (1927) studying experimental hyper- and hypothyroidism in dogs showed that cardiac output was increased by the former and decreased by the latter. The percentage change in

cardiac output was usually greater than the change in metabolic rate resulting from the experimental conditions.

Aub (1927) reported that blood calcium and blood phosphorus were normal in thyroid disease, but that the amounts excreted were far above normal. In normal controls thyroid administration raised the blood calcium and increased calcium excretion. In myxoedema the calcium metabolism was found to be lower than normal. In these cases also, thyroid administration caused the blood calcium and calcium excretion to be increased.

The relation of the thyroid to sexual maturation in the mammals is a matter of much controversy. The widely observed fact that thyroid disturbances occur far more frequently among girls and women than among boys and men received further attention in the statistical studies of the subject by Marine and Kimball (1917). That thyroid changes frequently occur in women during changes in ovarian activity (menarche, pregnancy, and menopause) is also a well-known fact. These facts do not, however, lead to the conclusion that the thyroid regulates sexual maturity in an individual, but rather that the sex of the individual in some measure, at least, determines the level of thyroid activity. This fact must be kept well in mind in considering the relation of the thyroid to sex development.

Experimental studies on mammals indicate that the thyroid is in no manner related to the maturation of sex. It will be observed that this conclusion is in accord with Weismann's theory of the independence of the germ cells from the soma.

Hammett (1926) found no relation between thyroid activity and the development of the reproductive system in the white rat. Conditions resulting from thyroidectomy and thyroid feeding were thought to be secondary to general disturbances in growth, and not specific for the reproductive system.

Da Costa and Carlson (1933) found that 60 female white rats fed 0.5 to 1.0 mg. of desiccated thyroid daily showed a slight acceleration in sexual maturation, while 41 females fed 5.0 to 10.0 mg. daily showed a retardation in sexual development. It is interesting here to note the difference in effect obtained with different doses. The lighter dosage was optimal for anabolism to be predominant, whereas the heavier dosage was conducive to a predominance in katabolism; hence in the former case there was an acceleration in total development (including sexual maturation) and in the latter, there was a general retardation. Males fed 0.5 to 1.0 mg. of the above-mentioned extract showed lighter testis weight than controls, even when the body weight of experimentals was greater than that of the controls. The same held true for 5.0 and 10.0 mg. daily fed to males.

The secretion of milk and of milk fat in mammals is undoubtedly under the regulation of the thyroid gland. The effect of thyroid feeding and thyroxin injections on the secretion of milk and on milk fat production in cows was discussed by Graham (1934a and 1934b). In the former paper, this worker reported that the addition of small amounts of thyroid to the diet of normal cows, when the curve of lactation was falling, caused a rapid rise in milk and milk fat production for a short time, after which the curve continued to follow the original declining trend. During the period of rising milk secretion which continues for some 4 to 6 weeks after parturition, thyroid feeding had no apparent effect on the amount of milk secreted. The conclusion was drawn that there is a relationship between total

metabolic rate and the secretion of milk and milk fat; the secretion being greater with a faster rate of metabolism. In the second study (1934b) Graham showed that thyroxin is the principle in the thyroid gland which causes a marked increase in the production of milk fat in cows. The rise in milk secretion following thyroxin injections showed large variations, giving evidence that the cause of the increase in total milk secretion may not be identical with cause of the rise in milk fat. Folley and White (1936) confirmed the work of Graham by showing that daily injections of thyroxin into cows in declining lactation increased the milk flow as well as the production of milk fat and non-fatty solids.

The effect of hyperthyroidism on the hair of mammals has also been studied by several workers. Zawadovsky (1926) found that thyroid feeding of dogs and guinea pigs causes a marked loss of hair, but with no apparent blanching of colors.

Chang (1926) reported that albino rats deprived of the thyroid gland showed a retardation of hair growth. Upon feeding suitable amounts of thyroid (0.5 to 0.7 g.) in doses of 0.03 g. per day, the hair grew normally. Undernourished animals with intact thyroids showed a similar retardation of hair growth. Thyroid fed to such animals kept on a starvation diet improved hair growth in spite of the further decreased body weight caused by excessive katabolism in addition to the originally deficient anabolism. These observations led to the conclusion that the thyroid has a specific influence on the growth of hair.

Sainton and Simonnet (1931) made a number of interesting observations on the influence of the thyroid on hair characteristics. In a clinical case of Basedow's disease, premature white hair was observed in members of three previous generations. In another case, a father and four sons having a malady similar to exophthalmic goitre showed premature yet complete gray hair at the age of 30 or under. In another case where the father had gray hair before 30, his daughter and granddaughter showed early signs of Basedow's disease. In several cases premature gray hair was observed in both the father and mother of hyperthyroid subjects. In another case Basedow's disease resulted in premature gray hair in patches in two brothers whose hair was noticeably scanty. The last case reported was that of a mother who had Basedow's disease, and her son and daughter were observed to have the disease at the age of 15 to 20. These observations indicated to the investigators that not only is the thyroid related to hair character, *but that phaenotypic changes acquired by hyperthyroidism are hereditary*. The experimental work on hyperthyroidism of birds and mammals indicate that it is not strange for gray hair and Basedow's disease to exist in ascendants and descendants, as observed in the clinical data. The conclusion is made that in all such cases as noted above, hyperthyroidism surely exists though its manifestations may present themselves in either the clinically typical form, or instead be only of a monosymptomatic nature, such as premature gray hair. In any event the hyperthyroid reaction appears to be transmitted to the progency of affected subjects, the mode of transmission, however, remaining obscure.

Cockayne (1928) made a study of the influence of heredity on exophthalmic goitre. His observations were based on carefully prepared family histories. The obvious conclusion reached was that since the disease is so rarely present at birth, so variable in its date of onset, and so often transmitted by apparently healthy parents, it is more easily explained on the

basis of an inherited constitutional weakness of the thyroid gland rather than of the inheritance of Graves' disease itself. The constitutional weakness appears to be inherited as a dominant, and some of those who inherit it may remain apparently healthy while others may develop any of the manifestations of the disease under the influence of injurious geographical influences.

Several experimental studies have been made on the inheritance of thyroid effects. Marza and Marza (1929) found a slight reduction in the weight of the thyroid glands of guinea pigs of thyroidectomized parents. Histologically, the differentiation of the cells of the gland was greatly retarded. Marza-Rusnac (1929) confirming the earlier work, reported that thyroidectomy in guinea pigs resulted in a decrease in size and weight of the thyroid gland of the new-born. The offspring of the thyroidectomized animals were definitely smaller and weaker at birth than the controls.

The relation of the thyroid function to temperament has studied by Brown and Gildea (1927). These investigators showed, on the basis of 15 cases, that there is a constitutional predisposition to hyperthyroidism, implying a sensitive thyroid gland as indicated by the high incidence of nervous irritability among relatives. Persons who are constitutionally so predisposed were found to have a feeling of personal insecurity, a strong sense of responsibility and a tendency to turn the effects of their emotional experiences within rather than give them outward expression, that is, to be typical introverts.

Studies on the normal function of the mammalian thyroid show conclusively that the gland is essential in the regulation of metamorphosis, growth, metabolism, hair growth, blood volume and composition, milk secretion, and even of temperamental characters. Thyroid feeding will cause an acceleration in the developmental processes, and naturally an increase in volume of the product developed; this, however, only so long as anabolism remains predominant. When the dosage is of such size that extreme hyperthyroidism sets in, with its accompanying predominance in katabolism, apparently anything can happen, the ultimate result usually being the death of the organism. The failure of the early workers to state the dosage of thyroid used in experimental feeding, and the failure of many of the later ones to determine the effect of a logically planned *range* of dosages have only tended to confuse the question of thyroid activity and to increase the ambiguity of experimental results and conclusions.

The above review of studies on the thyroid feeding of vertebrates brings several interesting facts to light. The first is that the vertebrate thyroid, which normally is an organ of internal secretion, delivering its product to the body parenterally, may, if eaten (which is to say, put into the body by the enteral route) induce definite and considerable changes in the physiology of the organism both immediately and over considerable periods of time. The second is that these changes, which are seen as accelerations of metamorphosis in amphibians, or of either the moulting cycle of feather production in birds, or of growth or of milk or milk fat secretion in mammals, are all manifestations or expressions of the metabolic regulator function of the gland which is its basic job.

(To be concluded)

SPECIES SPECIFICITY OF THE GONADOTROPIC FACTORS IN VERTEBRATES

By CHARLES W. CREASER
Wayne University
AND
AUBREY GORBMAN
University of California

MOST recent studies concerned with the pituitary secretions have revealed increasingly frequent reference to the factor of species variation in the elucidation of certain of the data. In 1929 Houssay found that pituitary implants from different vertebrate classes could not duplicate the phenomenon of ovulation induction as it was produced in the toad by homoplastic implants. He was probably the first to advance the hypothesis of gonadotropic hormone species specificity as a basis for the interpretation of these results. Since that time it has become definitely established that there is a variation in *quantity* of the anterior pituitary hormones from species to species. This fact has been sufficient to explain many cases of apparent irregularities in response, or in dosage required to produce a given response. In some cases, however, and especially those cases in which the hormone donor and recipient are of widely divergent taxonomic types, it becomes clear that a *qualitative* variation in the hormones, like that postulated by Houssay, must be given consideration. Such a conception represents an advance over the general opinion held by endocrinologists a few years ago as summarized by P. E. Smith (1932) "A species specificity either in a hormone or in the receptivity to a hormone is contrary to the current concept of hormonal physiology."

Since 1929 numerous instances of refractoriness of animals to pituitary hormones of extra-specific origin have been presented in the literature of endocrinology, and these have been explained in various ways. The possibility of hormone species specificity has often been proposed, but almost never systematically tested. In 1935 Creaser and Gorbman (1935, 1936) examined the refractoriness of the common leopard frog, *Rana pipiens*, to large doses of mammalian gonadotropic materials, in contrast to its ready response to homoplastic treatment or treatment with pituitaries from closely related species. They concluded after elimination of all factors, excepting those characteristic and common to the number of actual hormone mixtures tested, that a gonadotropic hormone species specificity has been demonstrated. The discovery of antihormones by Collip and Anderson (1934) directed considerable attention to the question of pituitary hormone species specificity inasmuch as a number of investigators have claimed that antihormones are merely antibodies formed in response to immunologically distinct, and therefore species specific, hormones.

The implication of hormone specificity in cases of chronic injection of anterior

pituitary substances, and the possible clinical significance of this specificity factor in the general ineffectiveness of animal pituitary extracts in humans indicate that hormone variation even between more closely related vertebrates may be of more than academic importance. Furthermore, to those who are impressed by the factor of species variation it seems that the validity of comparing values obtained in bioassay of different pituitary hormone preparations becomes liable to considerable doubt. Since a summarization of the data bearing upon pituitary hormone species specificity seems particularly valuable at the present time, it is proposed to include here such a review, as well as an amplification of some previous work on this problem with amphibia. The present consideration will be confined to the gonadotropic factors since these are the only ones which have been studied generally enough to allow comparisons.

Ample study by chemists has shown that the gonadotropic hormones cannot be disassociated from certain typical protein properties. In other words, these hormones are proteins, or are parts of stable protein complexes. This fact requires almost a priori that a species specificity exists in the hormone since it would be extremely unusual to find the hormone property associated with the same protein in more than one species. The task which must occupy the attention of those investigating this question is the determination of the physiological significance of such interspecific variation. The most direct method which suggests itself is the exchange of hormones between species to test the ability of these substances to produce their usual effects in other animal types.

It is unfortunate that much of the data of the most generally studied anterior pituitary factors, the gonadotropic hormones, cannot be clearly evaluated. Although some endocrinologists still point out that the existence of more than one hypophyseal gonadotropic hormone has not been absolutely demonstrated, it seems quite definitely established at the present time that different fractions may be obtained from the pituitary which affect different phases of gonadal activity. Thus, follicle-stimulating, lutein-stimulating, interstitial cell-stimulating, gonadotropic antagonist, and even other gonadotropic principles have been reported. Just as different threshold values may exist in different animals to the same pharmaceutical reagent, and varying proportions of reacting tissues may be present in the affected organs of different species, there must manifestly be a variety of reactions yielded by a number of test animal species treated with a given gonadotropic mixture. If variability between animal species in type and degree of reaction to gonadotropic hormones could be ascribed entirely to this quantitative variability in gonadotropic fractions, and test gonad threshold sensitivity, it could be construed that the species specificity is of negligible importance. This is no doubt largely correct in the interpretation of results from hormone exchanges between more closely related vertebrates, but as previously intimated, results of hormone exchanges between phylogenetically distant species cannot be successfully explained on a quantitative basis.

AMPHIBIA

Experiments with mammalian hypophyseal extracts in amphibia have furnished a fairly complete body of data indicating that qualitative hormone variation between these two classes is of sufficient value to reduce remarkably the efficiency of action of the hormones in reciprocal exchange. Apparently ovula-

tion is the only reaction of which the mature amphibian ovary, used in such experiments, is capable in order to indicate overtly the efficacy of the particular gonadotropic agent tested. Some amphibia are entirely refractory to large dosages of mammalian gonadotropic preparations of any kind. The high dosages administered and the variety of preparations used obviate almost any explanation of these facts on the basis of high threshold, or absence of the correct gonadotropic fraction to produce ovulation. The inadequacy of the threshold hypothesis may also be indicated from the fact that treatment with a very small amount of homoplastic pituitary material will invariably stimulate ovulation. That a substance is present in the experimentally ineffective extracts which is at least comparable to the amphibian ovulation-inducing factor, is seen in experiments with certain species of amphibia which can be made to ovulate with large doses of mammalian gonadotropic preparations. Of considerable interest in this regard are the corroborative experiments now being made by several investigators in which efforts are being made to ovulate *Rana pipiens* with large quantities of gonadotropic materials of mammalian origin. While these experiments have not been completed, we are permitted to say that even with large quantities of fresh mammalian material no ovulation has been produced. Recent work by Mayo (1937), reported in abstract, in which FSH and LH preparations (after Fevold's procedure) from sheep pituitary were tested in *Triturus viridescens*, indicates that ovulation may be stimulated by LH, and growth of the spent ovary proceeds more rapidly under the influence of repeated FSH injections than LH injections. However, in both cases ovary restoration was greater than in untreated animals.

Table I is a summary of the data which have been accumulated in work with the amphibia as test animals. This table reveals the fact that the reactivity of amphibia in general varies from complete refractoriness to relatively ready responsiveness to mammalian gonadotropic preparations. Those amphibia in which a response is produced by mammalian preparations require very large doses. One of the more sensitive amphibians, *Xenopus laevis*, which has been described as suitable for a pregnancy test (Bellerby, 1934; Shapiro and Zwarenstein, 1934), is treated with more than 1000 rat units of prolan to induce ovulation (calculated by Witschi, 1937, after data of Shapiro and Zwarenstein). On the other hand, all amphibian species which have been treated with homoplastic pituitary, including those which are completely refractory to mammalian pituitary, respond readily to a few milligrams of homoplastic tissue. We have found that dosages as high as 1700 rat units of prolan, 110 rat units of beef pituitary extract, 6.6 cc. of a crude extract of sheep pituitary, or 7.2 cc. of pregnant mare's serum extract (all extracts were Parke Davis & Company products) will not induce extra-seasonal ovulation in *Rana pipiens*. If some of the frogs which yielded these negative results were implanted with homoplastic pituitaries after a suitable interval, ovulation occurred after treatment with as few as two or three glands (about 5 milligrams of fresh tissue). Rarely was it necessary to use as many as eight or nine pituitaries. The ovary of *Rana pipiens* is also responsive to implants of hypophyses of other Anura (*Rana clamitans*, *Rana catesbeiana*, *Rana sphenocephala*, *Bufo marinus*, *Triturus viridescens*), but when considerable amounts of pituitaries of fish are used (perch, lake trout, wall-eye pike, dog shark) the same responsiveness can no

TABLE I

RECIPIENT	SOURCE OF PREPARATION	NATURE OF PREPARATION	RESULT	AUTHORITY	REMARKS
Ambystoma tigrinum	1 Sheep pituitary	1 Extract	1 +	1 Barth, Burns and Buyse	
	2 Beef (?) pituitary	2 Schering and Kahlbaum thyrotropic extract	2 +	2 Voss	
	3 Human pregn. urine	3 Extract	3 +	3 Barth, Ogilvie	
Bombinator pachypus	1 *Bombinator pachypus*	1 Fresh implants	1 +	(1–9) Moskowska	In 1 to 8 mixtures of several species used in some cases
	2 *Bombinator igneus*	2 Fresh implants	2 +		
	3 *Bufo viridis*	3 Fresh implants	3 +		
	4 *Bufo vulgaris*	4 Fresh implants	4 +		
	5 *Alytes obstetricans*	5 Fresh implants	5 +		
	6 *Rana esculenta*	6 Fresh implants	6 +		
	7 *Rana temporaria*	7 Fresh implants	7 +		
	8 *Triton cristatus*	8 Fresh implants	8 +		
	9 Beef	9 Alkaline extract	9 −		
Bufo americanus	1 *Rana pipiens*	1 Fresh implants	1 −	1 Bardeen	Negative result in 1 may be due to diseased animals
	2 *R. pipiens* plus *R. sphenocephala*	2 Fresh implants	2 +	2 Wills, Riley, and Stubbs	
	3 *Lepidosteus*	3 Fresh implants	3 +	3 Wills, Riley, and Stubbs	
	4 Albino mouse	4 Fresh implants	4 −	4 Wills, Riley, and Stubbs	
	5 Human pregn. urine	5 Extract	5 −	5 Kuyper Pfeiffer and Wills	
Bufo arenarum	1 *Bufo arenarum*	1 Fresh implants	1 +	1 Houssay	
	2 *Bufo arenarum*	2 Desiccated powder	2 +	2 Novelli	
	3 *Bufo d'orbignyi*	3 Fresh implants	3 +	3 Houssay	
	4 *Leptodactylus ocellatus*	4 Fresh implants	4 +	4 Houssay, Novelli	
	5 *Micropogon* (fish)	5 Fresh implants	5 −	5 to 13, Houssay *et al.*	
	6 *Xenodon* (snake)	6 Fresh implants	6 −		
	7 *Gallus* (hen)	7 Fresh implants	7 −		
	8 White rat	8 Fresh implants	8 −		
	9 Guinea pig	9 Fresh implants	9 −		
	10 Dog	10 Fresh implants	10 −		
	11 Beef	11 Fresh implants	11 −		
	12 Beef	12 Acid or alk. extract	12 −		
	13 Human pregn. urine	13 Extract	13 −		

	13 Human pregn. urine	13 Extract	13 −		
Bufo calamita	1 Ox 2 Human pregn. urine	1 Extract 2 Extract	1 − 2 −	1 and 2, Cunningham and Smart	
Bufo d'orbignyi	1 *Bufo d'orbignyi* 2 *Bufo arenarum* 3 *Leptodactylus ocellatus*	1 Fresh implants 2 Fresh implants 3 Fresh implants	1 + 2 + 3 +	1 to 3, Houssay	
Bufo fowleri	1 *Bufo fowleri* 2 *Rana catesbeiana* 3 *Rana clamitans* 4 *Rana palustris* 5 *Rana pipiens* 6 Sheep 7 Human pregn. urine	1 Fresh implants 2 Fresh implants 3 Fresh implants 4 Fresh implants 5 Fresh implants 6 Extract 7 Extract	1 + 2 + 3 + 4 + 5 + 6 + 7 +	1 to 7, Rugh	
Bufo vulgaris	1 *Bufo vulgaris* 2 *Rana vulgaris* 3 Rabbit 4 Beef 5 Beef 6 Human pregn. urine 7 Same as 5 and 6	1 Fresh implants 2 Fresh implants 3 Fresh implants 4 Fresh implants 5 Alkaline extract 6 Extract 7 Combined 5 and 6	1 + 2 − 3 − 4 − 5 − 6 − 7 −	1 Adams, Rostand 2 to 7, Adams	
Desmognathus fuscus	1 *Rana pipiens* 2 *R. pipiens* plus *Gyrinophilus*	1 Fresh implants 2 Fresh implants	1 + 2 +	1 and 2, Noble and Evans	No apparent gonad response in male
Discoglossus pictus	1 Beef	1 Alkaline extract	1 +	1 Kehl	
Eurycea bislineata	1 *Eurycea bislineata*	1 Fresh implants	1 +	1 Noble and Richards	No apparent response in male
Gyrinophilus porphyriticus	1 *Rana pipiens*	1 Fresh implants	1 +	1 Noble and Richards	No apparent response in male

TABLE I—*Continued*

RECIPIENT	SOURCE OF PREPARATION	NATURE OF PREPARATION	RESULT	AUTHORITY	REMARKS
Hyla aurea	1 Pregnant mare serum	1 Extract	1 +	1 Creaser and Gorbman	
Leptodactylus ocellatus	1 *L. ocellatus* 2 *Bufo arenarum* 3 *Bufo d'orbignyi* 4 Beef	1 Fresh implants 2 Fresh implants 3 Fresh implants 4 Alkaline extract	1 + 2 + 3 + 4 −	1 Houssay 2 Houssay, Novelli 3 Houssay 4 Novelli	
Pseudobranchus striatus	1 (Probably *Rana pipiens*) pituitary	1 Fresh implants	1 +	1 Noble and Richards	No apparent response in male
Rana aurora	1 *Rana aurora*	1 Fresh implants	1 +	1 Creaser and Gorbman	
Rana catesbeiana	1 *Rana clamitans* 2 *Rana pipiens* 3 Sheep 4 Human pregn. urine	1 Fresh implants 2 Fresh implants 3 Extract 4 Extract	1 + 2 + 3 − 4 +	1 to 4, Rugh	
Rana clamitans	1 *Rana clamitans* 2 *Rana catesbeiana* 3 *Rana palustris* 4 *Rana pipiens* 5 *Bufo fowleri* 6 Sheep 7 Human pregn. urine	1 Fresh implants 2 Fresh implants 3 Fresh implants 4 Fresh implants 5 Fresh implants 6 Extract 7 Extract	1 + 2 + 3 + 4 + 5 + 6 − 7 −	1 to 7, Rugh	
Rana esculenta	1 *Rana esculenta* 2 *Rana temporaria* 3 Carp 4 Whiting 5 Green lizard (*Lacerta viridis*?) 6 Chicken 7 Beef	1 Fresh implants 2 Fresh implants 3 Fresh implants 4 Fresh implants 5 Fresh implants 6 Fresh implants 7 Fresh implants	1 + 2 + 3 − 4 − 5 − 6 − 7 −	1 to 8, Rostand	
Rana esculenta—	8 (Beef?)	8 Extract	8 −		

Rana esculenta—Cont.	8	(Beef?)	8	Extract	8	−		
	9	Ox	9	Acid extract	9	−	9 Cunningham and Smart	
	10	Human pregn. urine	10	Extract	10	−	10 Cunningham and Smart, Rostand	
	11	Egg laying frog urine	11		11	−	11 Rostand	
Rana japonica	1	*Rana nigricauda*	1	Fresh implants	1	+	1 Osima	
Rana nigricauda	1	*Rana nigricauda*	1	Fresh implants	1	+	1 Osima	
Rana palustris	1	*Rana palustris*	1	Fresh implants	1	−	1 to 6, Rugh	Treatment started too soon afte laying season. + result in a later experiment
	2	*Rana catesbeiana*	2	Fresh implants	2	−		
	3	*Rana clamitans*	3	Fresh implants	3	−		
	4	*Rana pipiens*	4	Fresh implants	4	+ −		
	5	*Bufo fowleri*	5	Fresh implants	5	−		
	6	Sheep	6	Extract	6	−		
Rana pipiens	1	*Rana pipiens*	1	Fresh implants	1	+	1 Bardeen, Barth, Creaser and Gorbman, Rugh, Wolf	
	2	*Rana catesbeiana*	2	Fresh implants	2	+	2 Creaser and Gorbman	
	3	*Rana clamitans*	3	Fresh implants	3	+	3 Creaser and Gorbman	
	4	*Rana sphenocephala*	4	Fresh implants	4	+	4 Creaser and Gorbman	
	5	*Bufo marinus*	5	Fresh implants	5	+	5 Creaser and Gorbman	
	6	*Necturus maculosus*	6	Fresh implants	6	−	6 Creaser and Shcolnek	
	7	*Lepidosteus*	7	Fresh implants	7	+	7 Wills, Riley, and Stubbs	
	8	*Cristovomer namaycush*	8	Fresh implants	8	−	8 Creaser and Gorbman	
	9	*Perca flavescens*	9	Fresh implants	9	−	9 Creaser and Gorbman	
	10	*Stizostedion vitreum*	10	Fresh implants	10	−	10 Creaser and Gorbman	
	11	*Squalus suckleyi*	11	Fresh implants	11	−	11 Creaser and Gorbman	
	12	Sheep	12	Extract	12	−	12 Barth, Creaser and Gorbman, Rugh	
	13	Beef	13	Extract	13	−	13 Creaser and Gorbman	
	14	Pregnant mare serum	14	Extract	14	−	14 Creaser and Gorbman	
	15	Human pregn. urine	15	Extract	15	−	15 Barth, Creaser and Gorbman, Rugh	
	16	*Rana catesbeiana*	16	Fresh implants	16	−	16 Rugh	16 to 20 too soon after normal laying season
	17	*Rana clamitans*	17	Fresh implants	17	−	17 Rugh	
	18	*Rana palustris*	18	Fresh implants	18	−	18 Rugh	
	19	*Rana pipiens*	19	Fresh implants	19	−	19 Rugh	
	20	*Bufo fowleri*	20	Fresh implants	20	−	20 Rugh	

TABLE I—*Concluded*

RECIPIENT	SOURCE OF PREPARATION	NATURE OF PREPARATION	RESULT	AUTHORITY	REMARKS
Rana temporaria	1 *Rana temporaria*	1 Fresh implants	1 +	1 Rostand	
	2 *Rana esculenta*	2 Fresh implants	2 +	2 Rostand	
	3 Carp	3 Fresh implants	3 −	3 Rostand	
	4 Whiting	4 Fresh implants	4 −	4 Rostand	
	5 Green lizard	5 Fresh implants	5 −	5 Rostand	
	6 Chicken	6 Fresh implants	6 −	6 Rostand	
	7 Ox	7 Acid extract	7 +	7 Cunningham and Smart	
	8 Beef	8 Fresh macerated	8 +	8 Bellerby, Gallien	
	9 Beef	9 Fresh macerated	9 −	9 Rostand	
	10 Beef	10 Acid or alk. extract	10 +	10 Bellerby, Gallien, Ponse	
	11 Beef (?)	11 Extract	11 −	11 Rostand	
	12 Beef	12 Desiccated powder	12 ±	12 Gallien	
	13 Human pregn. urine	13 Extract	13 −	13 Cunningham and Smart, Gallien, Rostand	
	14 Castrate urine	14 Extract	14 −	14 Gallien	
	15 Same as 13 and 14	15 Combined 13 and 14	15 −	15 Gallien	
	16 Egg laying frog urine	16	16 −	16 Rostand	
Rana vulgaris	1 *Rana vulgaris*	1 Fresh implants	1 +	1 to 5, Adams	
	2 *Bufo vulgaris*	2 Fresh implants	2 +		
	3 Beef	3 Alkaline extract	3 +		
	4 Human placenta	4 Acid extract	4 −		
	5 Human pregn. urine	5 Extract	5 −		
Rhyacotriton olympicus	1 *Desmognathus, Eurycea* and *R. catesbeiana*	1 Fresh implants, mixed	1 +	1 Noble and Richards	No apparent response in male
Stereochilus marginatum	1 *Rana pipiens*	1 Fresh implants	1 +	1 Noble and Richards	
Triton cristatus	1 *Triton cristatus*	1 Fresh implants	1 +	1 Adams; Noble and Richards	
	2 *Rana pipiens*	2 Fresh implants	2 +	2 Adams	

Triturus pyrrhogaster	1 *T. pyrrhogaster*	1 Fresh implants	1 +	1 Barth	
	2 *Rana catesbeiana*	2 Fresh implants	2 +	2 Creaser and Gorbman	
	3 *Rana pipiens*	3 Fresh implants	3 +	3 Barth	
	4 Sheep pituitary	4 Extract	4 +	4 Creaser and Gorbman	
	5 Human pregn. urine	5 Extract	5 +	5 Barth, Creaser and Gorbman, Ogilvie	
Triturus torosus, T. similans, T. rivularis	1 *Triturus torosus, T. similans, T. rivularis*	1 Fresh implants	1 +	1 Twitty, Witschi	
	2 Bull pituitary	2 Extract	2 +	2 Witschi	
	3 Turkey pituitary	3 Extract	3 +	3 Witschi	
	4 Pregnant mare serum	4 Extract	4 −	4 Witschi	
Triturus viridescens	1 *T. viridescens*	1 Fresh implants	1 +	1 Adams, Barth, Morgan and Sondheim, Stein, Noble and Richards	
	2 *Bufo terrestris*	2 Fresh implants	2 +	2 Adams	
	3 *Rana pipiens*	3 Fresh implants	3 +	3 Adams, Barth, Dawson and Jiminez, Lipsett and Platt	
	4 Rooster or chick	4 Implant or powder	4 +	4 Stein	
	5 Beef	5 Extract (phyone)	5 +	5 Adams	
	6 Beef	6 Extract	6 −	6 Dawson and Jiminez	
	7 Sheep	7 Extract	7 −	7 Dawson and Jiminez	
	8 Human pregn. urine	8 Extract	8 +	8 Adams, Barth	
Xenopus laevis	1 Beef	1 Acid or alk. extract	1 +	1 Bellerby, Shapiro	
	2 Ox	2 Extract	2 +	2 Cunningham and Smart, Hogben	
	3 Human pregn. urine	3 Extract	3 +	3 Bellerby, Cunningham and Smart, Shapiro and Zwarenstein	

longer be demonstrated. As a matter of fact, recent work in this laboratory (Creaser and Shcolnek, 1939) shows that *Rana pipiens* will not respond by ovulation to doses of eighteen pituitaries of the urodele amphibian *Necturus maculosus*. Adams and Granger (1938a) have induced ovulation in *Rana pipiens* with from 40 to 90 glands obtained from *Triturus viridescens*. The only report of induced ovulation in *Rana pipiens* with fresh pituitary of a fish, *Lepisosteus* (garpike), was obtained in a single specimen treated by Wills, Riley, and Stubbs (1933b) who mention no control specimens. This report now seems rather doubtful and in need of checking in view of our negative results with five species of fish and with *Necturus*.

The male of *Rana pipiens* is far more sensitive to gonad stimulation than the female, and we have avoided a presentation of data from such animals in order to obviate misleading positive results. If placed in the presence of a female which has been stimulated by implants to ovulate out of season an untreated male *Rana pipiens* will almost invariably perform amplexus and will shed spermatozoa to fertilize released eggs. In contrast to most amphibia, viable spermatozoa may be obtained by testis maceration any time of the year from healthy males. It is also true of this species that the nuptial thumb pads remain large during the whole year, although they do grow even larger during the breeding season. Most other frogs during the non-breeding period have the thumb pads so reduced in size as to make it impossible to distinguish the hand of the male from the female. Wolf (1937) has reported shedding of sperm in isolated male *Rana pipiens* in response to frog pituitary implants, also to extracts of sheep and horse pituitary and pregnant mare's serum. In contrast with the unusual case of *Rana pipiens*, Houssay, Giusti, and Gonzalez (1929), Noble and Evans (1932), and Noble and Richards (1930a, 1930b, 1932) have described a number of cases in Amphibia in which stimulation of the male gonad proved more difficult than stimulation of the ovary.

Analysis of Table I furnishes at least one more important generalization concerning gonadotropic species specificity. It can be seen that whereas the responsiveness of any single species listed here can vary greatly, the limiting factor within the scale of responsiveness of the species in question is one of phylogenetic relation between donor and recipient of hormone. Since, with the possible though questionable exception of the datum of *Lepisosteus* pituitary in *Rana pipiens*, there is not a single exception to this generalization derived from the compiled work of so many investigators working with so many species, it should be granted considerable weight.

The apparently contradictory negative data of Rostand (1934) with fish, lizard, chicken, and beef material in the frog *Rana temporaria* are probably due to insufficient dosage, and cannot be granted any significance in view of their disagreement with the positive results of four other investigators with cattle pituitary preparations in this same test animal. On the one hand there are such resistant species as typified by *Bufo vulgaris* which will respond to homoplastic implants, but not to the pituitaries of another anuran, *Rana vulgaris*, or to considerable amounts of mammalian gonad stimulating preparations (Adams, 1931a). At the other extreme there are forms like *Triturus pyrrhogaster*, *Triturus viridescens* (Adams, 1930a, 1930b, 1931b, 1938), and *Bufo fowleri* (Rugh, 1935a), which, as reported, will respond to mammalian as well as to am-

phibian gonadotropins, although here too the phylogenetic limiting factor expresses itself in the extraordinary inefficiency of the mammalian substance in eliciting the same response ordinarily produced by a very small amount of homoplastic pituitary tissue. In our experience with *Triturus pyrrhogaster* fully ripe females respond quite regularly to a minimum of 100 to 120 rat units of prolan injected over a period of five to seven days, but will readily respond in a shorter time to 2 to 4 homoplastic implants, or even to a single adult *Rana catesbeiana* pituitary. Intermediate in responsiveness to extraspecific pituitary are *Bufo arenarum* which responds to homoplastic pituitaries and those of other Anura, but not to fish, reptile, bird, or mammal pituitary (Houssay *et al.*, 1929b); *Bufo americanus*, which responds to frog and fish pituitary but not to mammalian preparations (Kuyper *et al.*, 1933; Wills *et al.*, 1933a, 1933b); *Rana temporaria* and *Rana vulgaris* which respond to frog pituitary and certain mammalian preparations, but not others (Rostand, 1934; Gallien, 1937; Adams, 1931a). This apparent dependence of gonadotropic efficiency upon taxonomic relationships between hormone host and recipient rather than on the nature of the gonadotropic preparation indicates that species variation may be quite significant. This same phenomenon considered together with the variety of mammalian preparations which will produce ovulation in some Amphibia further indicate that perhaps several mammalian gonadotropic fractions can stimulate the same gonadal activity in amphibians, namely ovulation. As has been pointed out by Witschi (1937), this may be of some significance in the question of the evolution of separate gonadotropic factors in specialized vertebrates and should receive attention in future work with less specialized forms.

Treatment of mammals with amphibian pituitary has not been notably effective. Lipschütz and Paez (1928) found that doses of as many as 12 pituitaries of the large Chilean frog, *Calyptocephalus*, produced no gonad stimulation in the mouse. Similarly, Adams and Tukey (1937) reported that very large doses of leopard frog pituitary (16 to 96 glands) were without gonad stimulating action in the mouse. Zwarenstein (1937), however, reported that doses of South African clawed frog (*Xenopus laevis*) pituitary as high as 20 milligrams, implanted in immature mice, produced signs of ovary stimulation in opening of the vagina in ten out of twelve animals, increase in weight of the uterus, and *Blutpunkte* in both ovaries of two specimens, although no significant weight increase was noted in the stimulated gonads. Adams and Granger (1938b) have also reported ovary stimulation with amphibian pituitary (*R. pipiens*) in the mammal. They obtained increased weights in the uterus and vagina of the immature female test mice and histological evidence of ovary stimulation, but not a very marked increase in ovary weight. Using the immature rat as test animal, Benazzi (1937) has reported failure to produce gonad stimulation with anterior pituitary implants of a frog, *Discoglossus pictus*, or of the axolotl, *Ambystoma tigrinum*. Del Castillo and Novelli (1938) in a different type of experiment, found that combination of 5 pituitaries of the toad, *Bufo arenarum*, with prolan injections produced a significant increase in the weights of ovaries in the rat over the weights produced by prolan alone. It is difficult to generalize from such an incomplete series of data, but it does seem that higher doses of amphibian pituitary may be expected to exert a gonadotropic effect in mammals, in the same manner that high doses of mammalian prepara-

tions affect the amphibian gonad. Perhaps a mammal may be found with a more responsive gonad than the rat or the mouse, which will lend itself more readily to such experiments, and which might provide a more sensitive assay method for mammalian gonadotropic materials.

BIRDS

Although birds have been the subjects of extensive pituitary research, too few species have been studied, and too many different criteria of gonadotropic hormone activity have been utilized to permit a comparison like that made for the amphibia. In view of the striking difference in the sensitivity of birds to different mammalian gonadotropic fractions discussed by Evans and Simpson (1934), Breneman (1936), Domm (1937), and Witschi (1937), it would be hazardous to generalize from the few cases at hand. There is not only a large variation in gonad sensitivity between species of birds, but also a differential sensitivity between sexes in fowl, pigeons, and ducks. Age is also a basic factor, not only in the general sensitivity of the gonad, but also in its differential sensitivity to the various gonadotropic fractions. These facts appear in the work of Asmundson and Wolfe (1935), Breneman (1936), Domm and Van Dyke (1932), Krizenecky and Kamenicek (1933), Kroc and Breneman (1936), and others with fowl; Evans and Simpson (1934), Riddle and co-workers (1928, 1931, 1933), and others, with pigeons; Schockaert (1931a, 1931b, 1932) with ducks; Witschi and co-workers (1935, 1936, 1937) with finches and sparrows. Several interesting conditions have been found in avian subjects by application of heterologous gonadotropic materials. Practically all phases of gonadal activity have been stimulated by mammalian preparations, although a number of investigators have reported an inability to influence ovulation, or frequency of egg-laying, in poultry with such reagents. However, it has been uniformly reported by many workers that human pregnancy urine preparations have little or no effect in birds, even in extremely high dosage. Similarly, preparations of the luteinizing fraction from mammalian hypophyses were found by Breneman (1936) to be not only of much lower gonad stimulating activity than follicle stimulating preparations, but even had the property of reducing FSH potency if mixed with it. With these facts established, it is of extreme interest to learn that LH, a mammalian gonad stimulator, has been found to act directly on an integumentary structure, the feather, in finches (Witschi, 1937). Another surprising finding in birds is the report of Bates, Riddle, and Lahr (1937) describing an action (inhibitory) on the gonad of pigeons by the lactogenic hormone, which typically affects integumentary derivatives. To our knowledge, the only comparable report is that of Guyenot, Moskowska, and Ponse (1932) who claim that pituitary implants have a direct stimulating action on certain nuptial integumentary structures in a toad, *Bombinator*, even after castration.

It is therefore quite apparent that the factor of species specificity of gonadotropic hormones cannot be very readily evaluated in birds, at least from the available data. Some especially directed research is needed to make possible such an evaluation. The avian gonad seems to respond practically as well to heterozoic pituitary as to its own (Witschi, 1937). Nevertheless, it is prevailingly true of almost all work with the birds that very large doses, in terms of rat units, were used to produce the gonad stimulation discussed by the different authors. This point manifestly requires further study.

As a matter of fact, Kroc and Breneman (1936) point out the marked difference of potency of rat pituitary implants in homoplastic application, and in young chicks, and suggest a gonadotropic species variation as the basis for this result.

Bird pituitary applied in other vertebrate classes has yielded some interesting results. Houssay and Giusti (1929) and Creaser and Harkaway (unpublished data) have shown the inability of chicken pituitary to induce ovulation in the toad and the frog, respectively. Stein (1934), on the other hand, found that fairly large doses of fowl pituitary did provoke ovulation in the salamander, *Triturus viridescens*. Zavadovsky (1929) claims to have found chicken pituitary quite active in gonad stimulation in mice. In the early work of Smith and Engle (1927) pigeon pituitary transplants were found without gonad stimulating action in immature mice. Using somewhat larger doses of pigeon glands Lipschütz, Kallas, and Wilckens (1929) were able to demonstrate a slight gonad response in the mouse. Benazzi (1937) adds that doses of 11 pigeon pituitaries are without apparent effect in young rats. When such results are compared with the striking gonad stimulation produced in the immature rat or mouse by one or two homoplastic pituitaries, or glands from other mammals, the difference in potency assumes possible significance to the species specificity problem. Further, Riddle and Schooley (1935) demonstrated the definite effectiveness of as few as 5 homoplastic implants in the young pigeon. In the experiments of Riddle and Schooley 9 rat pituitaries produced a degree of weight stimulation in the immature pigeon testis comparable to that produced by the homoplastic treatment, furnishing an additional example of the apparently indiscriminating responsiveness of the bird gonad to extra-specific gonadotropic factors. It must be noted that in contrast to the results with pigeon pituitary, Witschi, Stanley, and Riley (1937) and Leonard (1937) found turkey and chicken pituitaries, respectively, to be quite potent in gonad stimulation in the rat.

REPTILES

The Reptilia have received scant attention from endocrinologists, but their importance from the phylogenetic standpoint invites further study. Mating behavior and histological evidence of gonad stimulation have been produced in the lizard, *Anolis*, by L. T. Evans (1933, 1935a, 1935b). Somewhat similar results were obtained by Herlant (1933) in the lizard, *Lacerta*, and the slow-worm, *Anguis*. Both of these workers used mammalian anterior pituitary and human pregnancy urine preparations. Cunningham and Smart (1934) report ovulation in *Lacerta* and *Anguis* after injection of a beef pituitary extract into fully ripe females. Large doses of sheep pituitary extract (9 to 18 cc. of Parke, Davis & Company extract in six weeks) produced slight gonad stimulation in young alligators in the experiments of T. R. Forbes (1934). In a recent paper presenting some work with the horned lizard, *Phrynosoma cornutum*, Mellish and Meyer (1937) provide some important data. They found that preparations of FSH, LH, and gonadotropic antagonist, each representing about 1.5 to 2.0 grams of fresh mammalian pituitary, and pregnant mare's serum extract, all lead to an increase in ovary weight due to increase in vascularity and yolk deposition in developing eggs. This striking demonstration of the ability of different gonadotropic fractions to elicit similar responses in a lower vertebrate lends confirmation to the same tendency observed in the amphibia. This phenomenon ad-

vances some interesting possibilities in connection with the evolution of the gonadotropic complex in higher vertebrates. Further study of the reptiles should prove a valuable source of information of this type.

In contrast to the obvious inefficiency of concentrated mammalian gonadotropic materials in reptiles are the experiments of Houssay (1930) who produced ovulation in the large snake *Xenodon merremi* with as few as five homoplastic pituitary implants. In the only reported case of application of reptilian hypophyses to another vertebrate type, Houssay and Giusti (1929) found that doses of 10 *Xenodon* whole pituitary implants gave no indication of gonad stimulation in the toad *Bufo arenarum*.

FISHES

Like the reptiles, the fishes should yield information of great interest to the comparative physiologist. At present the data of pituitary research is still too meager to permit generalization. Below the fishes in the chordate scale there is no organ comparable in structure and function to the pituitary body. The anatomical and physiological significance of pituitary structure and cytology in cyclostomes and elasmobranchs is still not clearly understood. In fact, the knowledge of the physiological significance of the pituitary of even the bony fishes can in no way be compared to that of the mammals, birds, and amphibians.

The interest in fishes as a basis for a pregnancy test has prompted a certain amount of study of the effect of mammalian gonadotropic hormones. The gonad stimulation of such preparations has in almost all reports been found lacking, or of negligible proportion by Fleischmann and Kann (1932) with prolan in the bitterling, Glaser and Haempel (1933) with mammalian pituitary extracts in the bitterling, Koch and Scheuring (1936) with prolan and pituitary extract in the rainbow trout, and Owen (1936) with prolan in the bitterling. In the rainbow trout experiment doses of prolan as high as 3000 rat units, administered in six divided doses, had no recognizable stimulating effect. However, all of such data, whether positive or negative, cannot be accepted unequivocally because of the variability among fishes with regard to the length of time during the year in which the gonad is fully mature. Certain authors have failed to observe this factor, as might be inferred from their failure to mention it, or to use fish in a definitely sexually inactive state, together with suitable controls.

Schreiber (1936) has reported the only clear instance of gonad stimulation in a fish with a mammalian preparation. In his work with the eel, *Anguilla*, he was able to stimulate spermatogenesis with 250 rat unit doses of prolan.

As in the case of the amphibia, homoplastic pituitaries or glands from other fishes are definitely more successful agents for gonad stimulation in fishes. Houssay (1931) has produced ovulation in the fish, *Cnesterodon decemmaculatus*, by 1 to 3 pituitary implants from two other fish species, *Micropogon opercularis* and *Luciopimelodus pati*. Von Ihering (1935) produced ovulation in sexually ripe female and male *Astyamax* and *Prochilodus* by treatment with less than 10 hypophyses from the fish *Hoplias malabaricus*. In an experiment with fish with very immature gonads, and therefore not comparable to those of the work of Houssay and von Ihering, Cardoso (1934) was able to stimulate growth in ovaries and testes of *Pimelodus clarias* with rather large doses of fish pituitaries. In these experiments 70 to 100 pituitaries administered over a

period of 10 to 18 days produced a great increase in gonad size over that of untreated controls (as much as five-fold). Since the pituitaries which were used weigh only .9 milligram, the dose was not as large as it might appear, but it would be of value to investigate the effect of mammalian hormones on an immature gonad to provide a comparison. Noble (1936) has been able to induce ovulation in the common aquarium fishes *Betta splendens* and *Lebistes reticulatus* with leopard frog pituitaries.

In some experiments, already briefly mentioned, large doses of whole pituitaries of various species of fishes were found unable to induce ovulation in mature frogs by Creaser and Gorbman (1935, 1936). Pituitaries from the perch, *Perca flavescens* (as many as 74), wall-eye pike, *Stizostedion vitreum* (16 glands), lake trout, *Cristovomer namaycush* (24 glands) were without gonad stimulating effect in *Rana pipiens*. In some recent experiments we have found *Rana pipiens* refractory to doses of 4 to 16 of the large pituitaries of the dog shark, *Squalus suckleyi*. These experiments are in agreement with the earlier work of Houssay (1929) who found that pituitaries of the shad were without effect in the toad *Bufo arenarum*. Wills, Riley, and Stubbs (1933b) have demonstrated a positive ovulation inducing capacity of *Lepisosteus* (gar pike) pituitaries in the toad *Bufo americanus*, and in one specimen of *Rana pipiens*. The latter datum deserves checking and should prove of considerable significance if verified, since *Lepisosteus* is phylogenetically more closely related to the amphibian forms than any of the fishes studied so far. Del Castillo and Novelli (1938), using rather small (*ca.* 13 milligrams) doses of fresh pituitary of four fish species: *Cynoscion striatus*, *Menidia platensis*, *Merluccius hubbsi*, and *Luciopimelodus pati*, were not able to produce any significant weight change in the ovaries of 30 to 50 gram rats.

In summary for this group it may be said that there appears to be a definite loss in gonadotropic efficiency in reciprocal pituitary exchange between the two phylogenetically distant vertebrate groups, the mammals and fishes. This may be contrasted to the ready effectiveness of homoplastic treatment in each of these groups. Between the fishes and the more closely related amphibia, although there is a marked reduction in gonadotropic efficiency in reciprocal pituitary exchange, at least two experiments reliably indicate the ability of each to produce ovulation in the other taxonomic group. As already pointed out, these conclusions require the weight of further experimentation.

ANTIHORMONES

If the gonadotropic hormones are associated with species specific proteins it would be expected that chronic injection of these substances in a foreign species would lead to the formation of specific antibodies antagonizing their action. Most of the recent work with these "antihormones" indicates that they are species-specific for the animal source of the hormone. There are already too many reviews of the antihormone problem (Collip, 1938; Gordon, 1937; Thompson, 1937a, 1937b) which attempt to collect and reconcile the voluminous and often controversial literature, to make necessary more than an outline of the main features of this work as they apply to the gonadotropic hormone species specificity problem.

That the "antihormone" is a serum antibody, and therefore produced by an immune response to a foreign protein, seems to be indicated by the ability of subminimal hormone doses to lead to its

appearance (Twombly, 1936), by the inability of large doses of homologous gonadotropins to produce the resistant state (Katzman, Wade, and Doisy, 1937), and by the apparent involvement of the reticulo-endothelial system in its production (Gordon, 1937). The actual demonstration of the antibody nature of the antihormones by the usual serological technics has proven elusive. Gustus, Meyer, and Dingle (1935), Brandt and Goldhammer (1936), and others have shown precipitin or complement-fixation titers do not parallel the antigonadotropic potency of resistant sera. In fact, Brandt and Goldhammer regard the method devised by Collip and Anderson (1934) for determining antihormone activity merely as another suitable procedure for demonstrating the antibody content of a serum produced against an antigen with a typical physiological action. As Zondek and Sulman (1937) have observed, a number of authors who have reported that antihormones produced by them inhibited hormones other than the one used in their production, failed to note whether the strength of the inhibition was the same in each case, or they neglected to use a procedure which could show this. Immunologists have long been able to show that antibodies may be partially effective against proteins slightly different from those proteins against which they were originally elicited. This fact may be the basis of the "partial-specificity" of antihormones reported by some authors. Rowlands (1938) has recently been able to produce "pro-gonadotropic" sera by chronic injection of certain heterologous gonadotropic extracts. He suggests that this result may be due to the appearance of antibodies against the gonadotropic antagonist. If such a contention can be maintained, it seems not improbable that antihormones are produced against each gonadotropic fraction in a given extract used in chronic injections. Such a phenomenon might be the basis of the "organ-specificity" noted by Zondek and Sulman (1937). This same possibility might be easily a factor accounting for the variation in the reported results in testing a given antihormone-containing serum against different gonadotropic extracts, and it might therefore be the reason for some of the disagreement in experiments designed to investigate the species specificity of antihormones. To the difficulties of obtaining uniform results in demonstration of antihormone species specificity can be added the fact that different extraction procedures may cause different kinds and degrees of denaturation. The reality of this possibility is revealed in the work of Werner (1936a, 1936b) and Spielman and Meyer (1938).

In summary, it may be concluded that antibody nature of serum antigonadotropic substances has been demonstrated beyond reasonable doubt. This fact in itself proves the existence of a species variation in gonadotropic materials. The actual demonstration of the species specificity of antihormones has been attended by certain difficulties, but most investigations devoted to the study of this point have succeeded in showing such a species specificity.

CONCLUSIONS

Further than providing a substantial confirmation of the existence of gonadotropic hormone species variation, the study of antihormones does not contribute to the species specificity problem. In the evaluation of the physiological significance of this hormone variation the more direct method of hormone exchange between species must be used. This method has shown, in spite of the confusing ele-

ment of the plurality of the gonadotropic factors, that the effectiveness of a gonadotropic hormone in a foreign species tends to vary directly with the phylogenetic proximity of the donor and recipient species. In some instances the loss in effectiveness in such a hormone exchange may be so great as to lead to an apparent refractoriness by the recipient species to rather large doses of the hormone. The presence and the possible practical significance of this species factor should be considered by all investigators who are treating animals with extra-specific gonadotropic materials. It is conceivable that this factor may be operating in the well-known unsatisfactory state of clinical pituitary therapeusis. Furthermore, it becomes clear that if there is an appreciable variation of responsiveness of a given test animal to hormones from different species sources, then bioassay "units" do not represent equivalent absolute units of hormone, but only the amount of hormone required to produce a given test reaction in the particular animal species under consideration. The amount of error introduced into bioassay by this factor remains to be ascertained.

SUMMARY

On the basis of experiments involving treatment of the leopard frog, *Rana pipiens*, with various extra-specific gonadotropic materials, and a review of the literature, it is concluded that a qualitative species variation exists in gonadotropic hormones. This variation may be great enough between widely separated donor and recipient species to lead to an apparent ineffectiveness of the hormone. The possible practical meaning of such a variation is discussed.

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LITERATURE CITED

ADAMS, A. E. 1930*a*. The induction of egg laying in *Triturus viridescens* by heteroplastic pituitary gland grafts. *Anat. Rec.*, 45: 250.

——. 1930*b*. Egg laying in *Triturus viridescens* following pituitary transplants. *Proc. Soc. Exp. Biol. and Med.*, 27: 433–435.

——. 1931*a*. Induction of ovulation in frogs and toads. *Proc. Soc. Exp. Biol. and Med.*, 28: 677–681.

——. 1931*b*. Egg laying in *Triturus viridescens* following implants of pituitaries of *Bufo terrestris*. *Anat. Rec.*, 48, Suppl.: 37.

——. 1934. The gonad- and thyroid-stimulating potencies of phyone and hebin. *Anat. Rec.*, 59: 349–362.

——, AND GRANGER, BARBARA. 1938*a*. Induction of ovulation in *Rana pipiens* by pituitaries of *Triturus viridescens*. *Proc. Soc. Exp. Biol. and Med.*, 38: 552–554.

——, AND ——. 1938*b*. Stimulation of the reproductive tract of the infantile female mouse by anuran anterior pituitary substance. *Proc. Soc. Exp. Biol. and Med.*, 38: 585–586.

——, AND MAYO, V. 1936. The gonad-stimulating potency of the pars anterior in normal and castrated newts. *Proc. Soc. Exp. Biol. and Med.*, 35: 227–231.

——, AND TUKEY, G. R. 1937. The reaction of certain endocrine glands of immature female mice treated with anuran anterior pituitary substance. *Anat. Rec.*, 67, Suppl.: 2.

ASMUNDSON, V. S., AND WOLFE, J. M. 1935. Effect of pregnant mare's serum on the immature fowl. *Proc. Soc. Exp. Biol. and Med.*, 32: 1107–1109.

BARDEEN, H. W. 1932. Sexual reactions of certain anurans after anterior lobe implants. *Proc. Soc. Exp. Biol. and Med.*, 29: 846–848.

BARTH, L. G. 1933. The use of pituitary implants and extracts for obtaining amphibian eggs out of season. *Collecting Net.* 8, 1, 7–8.

BATES, R. W., RIDDLE, O., AND LAHR, E. L. 1937. The mechanism of the anti-gonad action of prolactin in adult pigeons. *Am. Jour. Physiol.*, 119: 610–614.

BELLERBY, C. W. 1933*a*. The endocrine factors concerned in the control of the ovarian cycle. I, *Xenopus laevis* as test animal. *Biochem. Jour.*, 27: 615–620.

——. 1933*b*. The endocrine factors concerned in the control of the ovarian cycle. II. *Rana*

temporaria as test animal; action of anterior lobe extracts on the ovary. *Biochem. Jour.*, 27: 2022–2030.

——. 1934. A rapid test for diagnosis of pregnancy by ovulation of the South African clawed toad after pregnant urine administration. *Nature*, 133: 494.

Benazzi, M. 1937. Richerche comparative sul potere gonadotrope della preipofisi. *Monit. Zool. Ital.*, 47, Suppl.: 79–81.

Brandt, R., and Goldhammer, H. 1936. Die Spezifität der gonadotropen Hormone und ihrer Antiseren. *Ztschr. f. Immun. Forschung*, 88: 79–90.

Breneman, W. R. 1936. The effect on the chick of some gonadotropic hormones. *Anat. Rec.*, 64: 211–220.

Buyse, A., and Burns, R. K. 1931. Ovulation in the neotenic *Amblystoma tigrinum* following administration of extract of mammalian anterior hypophysis. *Proc. Soc. Exp. Biol. and Med.*, 29: 80–81.

Cardoso, D. M. 1934. Relations entre l'hypophyse et les organes sexuels chez les poissons. *Compt. rend. Soc. de Biol.*, 115: 1347–1349.

Del Castillo, E. B., and Novelli, A. 1938. Actions gonadotropiques ou antagoniste de l'hypophyse des poissons, des batraciens, et des oiseaux. *Compt. rend. Soc. de Biol.*, 127: 1043–1044.

Collip, J. B. 1938. Anti-hormones. VII, The Pituitary Gland. Assoc. for Research in Nerv. and Ment. Disease, 268–275.

——, and Anderson, E. M. 1934. The production of serum inhibitory to the thyrotropic hormone. *Lancet* (1934): 76–78.

Creaser, C. W., and Gorbman, A. 1935. Apparent specificity of the induced ovulation reaction in amphibia. *Am. Jour. Physiol.*, 113: 32.

——, and ——. 1936. Specificity of the pituitary gonadotropic factor as demonstrated in amphibia. *Copeia*, no. 2: 91–95.

——, and ——. 1937. Specificity of the pituitary gonadotropic factor in amphibians as demonstrated by implants obtained from fishes. *Anat. Rec.*, 67, Suppl.: 83.

——, and Shcolnek, M. 1939. Specificity of the pituitary gonadotropic factors within the amphibia. *In Michigan Acad. Sci. Arts, and Letters.*, 25: 85–94.

Cunningham, J. T., and Smart, W. A. M. 1934. The structure and origin of corpora lutea in some of the lower vertebrata. *Proc. Roy. Soc., London*, 116B: 258–281.

Dawson, A. B., and Jiminez, R. J. 1933. The response of the hedonic glands of the male *Triturus viridescens* to heteroplastic implants of anterior pituitary. *Anat. Rec.*, 55: 279–290.

Domm, L. V. 1931. Precocious development of sexual characters in the fowl by homeoplastic hypophyseal implants. I. The male. *Proc. Soc. Exp. Biol. and Med.*, 29: 308–310. II. The female. *Proc. Soc. Exp. Biol. and Med.*, 29: 310–312.

——. 1937. Observations concerning anterior pituitary-gonadal interrelations in the fowl. *In* Cold Spring Harbor Symposia on Quant. Biol., V: 241–257.

——, and Van Dyke, H. B. 1932. Precocious development of sexual characters in the fowl by daily injections of hebin. I. The male. *Proc. Soc. Exp. Biol. and Med.*, 30: 349–351. II. The female. *Proc. Soc. Exp. Biol. and Med.*, 30: 351–353.

Evans, H. M., and Simpson, M. E. 1934. Response of gonads of immature pigeons to various gonadotropic hormones. *Anat. Rec.*, 60: 405–422.

Evans, L. T. 1933. Winter mating and fighting behavior of *Anolis carolinensis* as induced by pituitary injections. *Copeia*, 1: 3–6.

——. 1935*a*. The effect of pituitary implants and extracts on the genital system of the lizard, *Anolis carolinensis*. *Science*, 81: 468–469.

——. 1935*b*. The effect of antuitrin-S on the male lizard, *Anolis carolinensis*. *Anat. Rec.*, 62: 213.

Fleischmann, W., and Kann, S. 1932. Über eine Funktion des weiblichen Sexualhormons bei Fischen (Wachstum des Legeröhres des Bitterlings). *Pflüger's Arch. f. d. ges. Physiol.*, 230: 662–667.

Forbes, T. R. 1934. The effect of injections of whole gland extract on immature alligators. *Proc. Soc. Exp. Biol. and Med.*, 31: 1129–30.

Gallien, L. 1937. Action comparée des extraits hypophysaires et des substances gonadotropes de l'urine sur l'ovulation chez *Rana temporaria* L. *Compt. rend. Soc. de Biol.*, 124: 874–877.

Glaser, E., and Haempel, O. 1933. Testierung von männlichen Sexualhormon mit Fischen. *Klin. Wochenschr.*, 12: 1491–1494.

Gordon, A. S. 1937. The relation of the reticuloendothelial system to the anti-hormones. *In* Cold Spring Harbor Symposia on Quant. Biol., V: 419–427.

Gustus, E. L., Meyer, R. K., and Dingle, J. H. 1935. The relationship of precipitin titers to gonadotropic inhibitory action of monkey sera. *Proc. Soc. Exp. Biol. and Med.*, 33: 257–261.

Guyenot, E., Moskowska, A., and Ponse, K. 1932. Action directe de l'hypophyse sur les

excroissances nuptiales de *Bombinator pachypus*. *Compt. rend. Acad. des Sci.*, 194: 206–208.

HERLANT, M. 1933. Recherches histologiques et expérimentals sur les variations cycliques du testicule et des caractères sexuels secondaires chez les reptiles. *Arch de Biol.*, 44: 347–468.

HOGBEN, L., CHARLES, E., AND SLOME, D. 1931. Studies on the pituitary. VIII. The relation of the pituitary gland to calcium metabolism and ovarian function in *Xenopus*. *Jour. Exp. Biol.*, 8: 345–354.

HOUSSAY, B. A. 1930. Accion sexual de la hipofisis en los peces y reptiles. *Rev. de la Soc. Arg. Biol.*, 6: 686–688.

——. 1931. Action sexuelle de l'hypophyse sur les poissons et les reptiles. *Compt. rend. Soc. de Biol.*, 106: 377–378.

——, AND GIUSTI, L. 1929. Las funciones de la hipofisis y la region infundibulatuberiana en el sapo, *Bufo marinus* (L.) Schneid. *Rev. Soc. Arg. Biol.*, 5: 47–65.

——, AND ——. 1930*a*. Fonction sexuelle, hypophyse et hypothalamus chez le crapuad. *Compt. rend. Soc. de Biol.*, 114: 1030.

——, AND ——. 1930*b*. Funciones de la hipofisis y de la region infundibula-tuberiana del sapo *Bufo arenarum* (Hens.) *Rev. Soc. Arg. Biol.*, 6:206–2.5.

——, ——, AND LASCANO-GONZALEZ, J. M. 1929*a*. Implantacion de la hipofisis y estimulacion sexual en el sapo. *Rev. Soc. Argent. Biol.*, 5: 397–418.

——, ——, AND ——. 1929*b*. Implantation d'hypophyse et stimulation des glandes et des fonctions sexuelles du crapaud. *Compt. rend. Soc. de Biol.*, 102: 864–866.

——, AND LASCANO-GONZALEZ, J. M. 1929. L'hypophyse et le testicule chez le crapaud, *Bufo marinus*. *Compt. rend. Soc. de Biol.*, 101: 938–940.

VON IHERING, R. 1935. Die Wirkung von Hypophyseninjektion auf den Laichakt von Fischen. Kannibalismus bei Diplopoden. *Zool. Anzeig.*, 11: 273–279.

KATZMAN, P. A., WADE, N. J., AND DOISY, E. A. 1937. Effects of chronic implantation of rats with pituitaries of the same species. *Endocrinology*, 21: 1–7.

KEHL, R. 1930*a*. Action d'un extrait d'hypophyse antérieure de mammifère sur la ponte des batraciens. *Compt. rend. Soc. de Biol.*, 103: 744–745.

——. 1930*b*. Action de certains extraits retirés du lobe antérieure de l'hypophyse des mammifères sur le tractus genital des batraciens. *Bull. Soc. Hist. Nat. Afrique du Nord*, 21: 4–5.

——. 1935. Mode d'action des extraits hypophysaires antérieures de mammifères sur les caractères sexuels secondaires du discoglosse mâle. *Compt. rend. Soc. de Biol.*, 120: 10–12.

KOCH, W. 1935. Über den Einfluss von Prolan auf die Legetätigkeit der Vögel. II. Die Beeinflussung der Legetätigkeit normal Legender Hennen. *Klin. Wochenschr.*, (1935) II: 1850–1851.

——, AND SCHEURING, L. 1936. Die Wirkung von Hypophysenvorderlappenhormon auf den Laichakt von Fischen. *Zool. Anzeig.*, 116: 62–64.

KŘÍŽENECKÝ, J., AND KAMENIČEK, L. F. 1933. Is it possible to stimulate sexual development in poultry by the so-called gonadotropic substance? *Vestnik Československ. Akad. Zem.*, 9: 537–540.

KROC, R. L., AND BRENEMAN, W. R. 1936. Response of chick ovaries and testes to rat pituitary implants. *Proc. Soc. Exp. Biol. and Med.*, 35: 381–383.

KUYPER, A. C., PFEIFFER, C. A., AND WILLS, I. A. 1933. Failure of hebin to cause ovulation in toads. *Proc. Soc. Exp. Biol. and Med.*, 30: 413–414.

LEONARD, S. L. 1937. Luteinizing hormone in bird hypophyses. *Proc. Soc. Exp. Biol. and Med.*, 37: 566–568.

LIPSCHÜTZ, A., KALLAS, H., AND WILCKENS, E. 1929. Physiologie comparée du lobe antérieure de l'hypophyse. *Compt. rend. Soc. de Biol.*, 100: 28–29.

——, AND PAEZ, R. 1928. Etude expérimentale sur les relations entre les corps adipeux des glandes sexuelles et l'hypophyse. *Compt. rend. Soc. de Biol.*, 99: 693–694.

LIPSETT, J. C., AND PLATT, J. 1936. Experimental hybridization of *Triturus v. viridescens* and *Triturus v. symmetrica*. *Copeia*, 1: 1–4.

MAYO, V. 1937. Some effects of mammalian follicle-stimulating and luteinizing hormones in adult female urodeles. *Biol. Bull.*, 73: 373–374.

MELLISH, C. H., AND MEYER, R. K. 1937. The effects of various gonadotropic substances and thyroxin on the ovaries of horned lizards (*Phrynosoma cornutum*). *Anat. Rec.*, 69: 179.

MORGAN, A. H., AND SONDHEIM, S. C. 1932. Attempts to reduce the gills in neotenous newts, *Triturus viridescens*. *Anat. Rec.*, 52: 7–23.

MOSKOWSKA, A. 1932. Etudes endocrinologiques (testicule et hypophyse) chez le *Bombinator*. *Bull. Biol. France et Belg.*, 66: 502–551.

NOBLE, G. K. 1931. The Biology of the Amphibia. McGraw-Hill Book Company, *New York*. I. XIII. 1–577.

——. 1936. The function of the corpus striatum in the social behavior of fishes. *Anat. Rec.*, 64, Suppl.: 34.

——, AND EVANS, G. 1932. Observations and ex-

periments on the life history of the salamander, *Desmognathus fuscus fuscus*. *Am. Museum Novitates*, no. 533.

——, AND RICHARDS, L. B. 1930*a*. The induction of ovulation in salamanders by anterior pituitary transplants. *Anat. Rec.*, 45: 274–275.

——, AND ——. 1930*b*. The induction of egg laying in the salamander, *Eurycea bislineata*, by pituitary implants. *Am. Museum Novitates*, no. 396.

——, AND ——. 1932. Experiments on the egg laying of salamanders. *Am. Museum Novitates*, no. 513.

NOVELLI, A. 1932*a*. Action sexuelle du lobe antérieure de l'hypophyses chez le crapaud femelle. *Compt. rend. Soc. de Biol.*, 111: 474–475.

——. 1932*b*. Rôle de la castration sur l'action sexuelle de l'hypophyse du crapaud. *Compt. rend. Soc. de Biol.*, 111: 476–477.

OGILVIE, A. E. 1933. Induced ovulation in amphibians by injection of antuitrin-S. *Proc. Soc. Exp.* Biol. and Med., 30: 752–753.

OSIMA, M. 1937. Experimental studies on the function of the anterior hypophysis. I. Induced sexual activity in the frogs. *Science Reports of the Tohoku Imperial University* (*Biol.*), 4 s., 12: 195–202.

OWEN, S. E. 1936. The reaction of fish to sex hormones. *Endocrinology*, 20: 214–218.

PONSE, K. 1936. La ponte artificielle chez *Rana temporaria*. *Compt. rend. Soc. de Biol.*, 121: 1397–1400.

RIDDLE, O., AND BATES, R. W. 1933. Concerning anterior pituitary hormones. *Endocrinology*, 17: 689–698.

——, AND FLEMION, F. 1928. Studies on the physiology of reproduction in birds. XXVI. The rôle of the anterior pituitary in hastening sexual maturity in ring doves. *Am. Jour. Physiol.*, 87: 110–123.

——, AND POLHEMUS, I. 1931. Effects of anterior pituitary hormones on gonads and other organ weights in the pigeon. *Am. Jour. Physiol.*, 98: 121–130.

——, AND SCHOOLEY, J. P. 1935. Absence of follicle-stimulating hormone in pituitaries of young pigeons. *Proc. Soc. Exp. Biol. and Med.*, 32: 1610–1614.

ROSTAND, J. 1934. Hypophyse et ovulation chez les batraciens. *Compt. rend. Soc. de Biol.*, 117: 1079–1081.

——. 1935. Limites saisonières de l'ovulation chez les batraciens. *Compt. rend. Soc. de Biol.*, 120: 336–338.

ROWLANDS, I. W. 1938. Pro-gonadotropic sera. *Proc. Roy. Soc., B*, 124: 492–503.

RUGH, R. 1934. Induced ovulation and artificial fertilization in the frog. *Biol. Bull.*, 66: 22–29.

——. 1935*a*. Pituitary-induced sexual reactions in the anura. *Biol. Bull.*, 68: 74–81.

——. 1935*b*. Ovulation in the frog. I. Pituitary relations in induced ovulation. II. Follicular rupture to fertilization. *Jour. Exp. Biol.*, 71: 149–193.

——. 1937*a*. A quantitative analysis of the pituitary-ovulation reaction in the frog (*Rana pipiens*). *Physiol. Zool.*, 10: 84–99.

——. 1937*b*. Release of spermatozoa by anterior pituitary treatment of the male frog. *Rana pipiens*. *Proc. Soc. Exp. Biol. and Med.*, 36: 418–420.

——. 1937*c*. Ovulation induced out of season. *Science*, 85: 588–589.

SCHOCKAERT, J. 1931*a*. Action de substances prehypophysaires de mammifères sur le testicule du canard impubère. *Compt. rend. Soc. de Biol.*, 108: 429–431.

——. 1931*b*. Response of the male genital system of the immature domestic duck to injections of anterior pituitary substances. *Anat. Rec.*, 50: 381–397.

——. 1932. Unpublished data included in: ALLEN, E., 1932. Sex and Internal Secretions. Williams and Wilkins Co., *Baltimore*. 778.

SCHREIBER, B. 1936. Ulterori osservazioni sugli elementi della linea germinale maschile in anguille maturate artificialmente con prolan. *Monit. Zool. Ital.*, 47 suppl.: 197–200.

SHAPIRO, H. A. 1935. Experimental induction of coupling in *Xenopus laevis* with production of fertilized eggs. *Nature*, 135: 510.

——. 1936. The biological basis of sexual behavior in amphibia. I. The experimental induction of the mating reflex (coupling) in *Xenopus laevis* (the South African clawed toad) by means of pregnancy urine and of anterior pituitary extracts, with the production of fertilized ova. II. The independence of ovulation and of coupling (the mating reflex) in *Xenopus laevis* (the South African clawed toad). *Jour. Exp. Biol.*, 13: 48–59.

——, AND ZWARENSTEIN, H. 1934. A rapid test for pregnancy on *Xenopus laevis*. *Nature*, 133: 339 and 762.

——, AND ——. 1935. A test for the early diagnosis of pregnancy on the South African clawed toad (*Xenopus laevis*). *South Afr. Med. Jour.*, 9: 202–205.

SMITH, P. E. 1932. *In*: ALLEN, E., Sex and Internal Secretions. Williams and Wilkins Co., Baltimore.

——, AND ENGLE, E. T. 1927. Experimental evidence regarding the rôle of the anterior pituitary in the development and regulation of the genital system. *Am. Jour. Anat.*, 40: 159–217.

SPIELMAN, M. A., AND MEYER, R. K. 1938. Electrophoresis of prolan. *Proc. Soc. Exp. Biol. and Med.*, 37: 623–626.

STEIN, K. F. 1934. Effects of avian pituitary glands in salamanders. *Proc. Soc. Exp. Biol. and Med.*, 32: 157–161.

THOMPSON, K. W. 1937*a*. Inability of sheep to develop antihormone to the gonadotropic hormone from sheep pituitary glands. *Proc. Soc. Exp. Biol. and Med.*, 35: 634–636.

——. 1937*b*. The augmentary factor in animal sera after injections of pituitary extract. *Proc. Soc. Exp. Biol. and Med.*, 35: 640–644.

TWITTY, V. C. 1936. Correlated genetic and embryological experiments on *Triturus*. *Jour. Exp. Zool.*, 74: 239–302.

TWOMBLY, G. H. 1936. Studies of the nature of antigonadotropic substances. *Endocrinology*, 20: 311–317.

VOSS, H. 1934. Künstliche Eiablange beim Axolotl hervorgerufen durch das thyreotrope Hypophysenvorderlappenhormon. *Arch. f. Entwicklungsmech.*, 132: 805.

WERNER, S. C. 1936*a*. Prolonged injection of a thyrotropic extract without development of refractoriness. *Proc. Soc. Exp. Biol. and Med.*, 34: 390–392.

——. 1936*b*. Antibody nature of refractoriness to injections of hypophyseal extracts containing thyrotropic hormone. *Proc. Soc. Exp. Biol. and Med.*, 34: 392–394.

WILLS, I. A., RILEY, G. M., AND STUBBS, E. M. 1933*a*. Non-specificity of anuran hypophyses in induction of ovulation in toads. *Proc. Soc. Exp. Biol. and Med.*, 30: 411–412.

——, ——, and ——. 1933*b*. Further experiments on the induction of ovulation in toads. *Proc. Soc. Exp. Biol. and Med.*, 30: 784–786.

WITSCHI, E. 1936. Effect of gonadotropic and estrogenic hormones on regenerating feathers of weaver finches. *Proc. Soc. Exp. Biol. and Med.*, 35: 484–489.

——. 1937. Comparative physiology of the vertebrate hypophysis (anterior and intermediate lobes). *In* Cold Spring Harbor Symposia on Quant. Biol., 5: 180–190.

——, AND KECK, W. N. 1935. Differential effect of some gonadotropic substances on development of cyclical sex characters in the English Sparrow. *Proc. Soc. Exp. Biol. and Med.*, 32: 598–603.

——, STANLEY, A. J., AND RILEY, G. M. 1937. Gonadotropic hormones of the hypophysis of the turkey. *Proc. Soc. Exp. Biol. and Med.*, 36: 647–651.

WOLF, O. M. 1929*a*. Effect of daily transplants of anterior lobe of pituitary on reproduction of frog. *Proc. Soc. Exp. Biol. and Med.*, 26: 692–693.

——. 1929*b*. Effect of daily transplants of anterior lobe of pituitary on reproduction of frog. *Anat. Rec.*, 44: 206.

——. 1937. Induced breeding reactions in isolated male frogs, *Rana pipiens* Schreber. *Biol. Bull.*, 73: 399.

ZAWADOWSKY, B. 1929. The frontal lobe of the hypophysis as the driving power for the sex glands. *Am. Jour. Physiol.*, 90: 567.

ZONDEK, B., AND SULMAN, F. 1937. The antigonadotropic factor. Species specificity and organ specificity. *Proc. Soc. Exp. Biol. and Med.*, 36: 712–717.

ZWARENSTEIN, H. 1937. Gonadotropic activity of amphibian anterior pituitary. *Nature*, 140: 588.

NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will frequently appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to Dr. Raymond Pearl, Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *1901 East Madison Street, Baltimore, Maryland, U. S. A.*

ECOLOGY LOOKS HOMEWARD

Being a review of *Plant and Animal Communities*. (Notre Dame, Ind., The University Press, 1939. Pp. 1–255.)

By Thomas Park, Hull Zoological Laboratory, The University of Chicago.

I

It is no longer front page news to report that ecology is seriously in need of a thorough housecleaning followed by a well-planned program of refurbishing. Such a conviction has been smoldering and growing among biologists for several decades past. Happily, certain ecologists of critical mind have shared this general opinion and are attempting to do something about it. The present review hopes to evaluate some of the measures that are being tried. The ills of ecology are not necessarily unique to that discipline but are, in part, the common inheritance of all rapidly growing sciences. In the stricter sense genetics and ecology were both conceived in the nineteenth century and born around nineteen hundred. Genetics was a lusty infant even at birth and soon attained the modish position it occupies today. Ecology grew falteringly and, as was also true of early genetics, exhibited a great amount of careless observation and experiment, misdirected over-enthusiasm and lack of intellectual focus. The unfortunate point is that ecology still makes just these same errors. There seems no doubt but that the field should occupy a real place in theoretical biology, but is it moving in that direction; and, if so, is it moving there as surely and as swiftly as other biological disciplines? The answer to this question must be a somewhat evasive one. Part of the difficulty lies in the fact that ecology is an unfocussed field from both the historical as well as the modern viewpoint. The antecedents of ecology were varied. Around the turn of the century it drew principally upon natural history, general physiology, taxonomy, and physiography. It soon became apparent that the mere inclusion of certain facts from certain fields would neither develop nor constitute a self-delineated biological discipline. So, other fields were rapidly drawn in—more analytical aspects of biology, statistics, demography, climatology, and so on. The result, while expanding the frontier, bewildered even more the major issues. To make matters worse the ecologists working with animals and plants rapidly took out divorce papers on the grounds of incompatibility. This soon reached a state where, in an academic Nature, plants were completely independent of animals and animals were only crudely dependent upon plants.

What has this somewhat sombre preamble to do with the book under review? I think the answer is clear. Lately there are signs that ecology is trying to put its house in order. These signs are not numerous. Frequently they point to the

left rather than to the right. However, there is a chance that they presage an ecological millennium. Let us examine critically the book, *Plant and Animal Communities* in this light.

In the late summer of 1938 a group of plant and animal ecologists were invited to Cold Spring Harbor for a week to present papers dealing with selected phases of ecology. The *entrepreneurs* of the symposium were Doctor Stanley A. Cain (a contributor) and Doctor Theodor Just (editor of the proceedings). The motives underlying the symposium were somewhat similar to those just discussed. It was felt that ecologists working in diverse aspects of their subject should be brought together and through discussion, both leisurely and formal, stimulate each other and arrive at higher-order concepts. Actually this was an ideal not attained. The meetings enunciated neither new nor revolutionary ideas and directly did little to integrate a field badly in need of integration. What did happen, and herein lies the first value of the symposium, was that ecologists found themselves when assembled fairly self-critical and ready to attack time-honored but rather pristine traditions. In short, some good guns were fired. This is a valuable point to emphasize since it is not so detectable in reading the book, and, since indubitably it was the high point of the effort.

II

Let us turn our attention to a more conventional side of reviewing. The symposium and the book consisted of the following ten papers:

(1) Plant Associations on Land. Henry S. Conard.
(2) Littoral Marine Communities. G. E. MacGinitie.
(3) Fresh-Water Communities. Frank E. Eggleton.
(4) The Biome. J. Richard Carpenter.
(5) The Individualistic Concept of the Plant Association. H. A. Gleason.
(6) The Unistratal Concept of Plant Communities (The Unions). Theodor Lippmaa.
(7) The Climax and its Complexities. Stanley A. Cain.
(8) Social Coördination and the Superorganism. Alfred E. Emerson.
(9) On the Analysis of Social Organization among Vertebrates, with Special Reference to Birds. N. Tinbergen.
(10) Analytical Population Studies in Relation to General Ecology. Thomas Park.

It is patent from the list of titles and authors that the proceedings were diverse and far from comprehensive. As mentioned earlier this was part of the original plan. It would be redundant to review each paper in detail but certain points lend themselves for discussion.

Interestingly enough, the botanists and zoölogists, by and large, were concerned with different aspects of ecology. This is significant because it stresses the fact that bio-ecology is a neat term as well as a desideratum, but, to date is far from actual realization. Of the two groups, the botanists were more unified in that their polemics centered largely around ecological terminology. This meant that ideas and discussions were sprightly, entertaining, occasionally valueless and even apologetic—*qui s'excuse s'accuse*. There is a tendency in scientific work for a term *per se* to possess great personal emotional appeal. A value of the Cold Spring Harbor papers was that they tore down many terms, patently bad, and ofttimes, though not always, developed *concepts* to which a term could be assigned. These concepts revolved about methods of organizing the plant community. The plant ecologists asked this commendable question: granting that there are associations of plants extending over the earth, and, granting that these associations have a certain biological unity, how may the basic organization of such communities best be analyzed? I think this is a reasonable statement of the interests of many of the botanists present. In answering the question, however, diverse opinions became apparent. In certain cases it appeared that these opinions lacked a factual background; in other cases, they seemed to be adequately substantiated.

Conard, in a paper particularly noteworthy for its historical approach, stressed the new development of plant sociology. He defines the goals of this field (p. 22) as, "(1) An understanding of the Order of Nature," and (2) "Directions for the wisest use of the land." The field of plant sociology was also represented by Lippmaa who developed the "unistratal" concept of plant community analysis.

This concept holds that floral associations are subdivisible into basic units that represent strata or layers in the community. These units are supposed to have an ecological reality. It is suggested that they can be studied as centers of organization and analyzed in terms of their intra- and inter-competetive relations. "The elementary units of homogeneous and relatively stabilized vegetation (*i.e.*, in equilibrium with the habitat) are one-layered associations, characterized by a definite floristic composition and by their ecology." (p. 118)

A different approach to the same general issue was developed by Carpenter in his paper on the "biome." Instead of primarily stressing a small unit as did Lippmaa and building up from that point, the protagonists of the biome concept reverse the procedure, stress a floristic and faunistic unit of geographic extent and work down to smaller categories. Carpenter gives the following definition of the biome: (p. 75)

> The primary unit of bioecology is the biome, a community of formational rank in the largest sense of the term. The biome is characterized by uniformity of physiognomy of the plant climaxes and in a lesser way by the climax stages. It is characterized by a combination of major and minor influent animals, a few climax influents, and many small influents and subinfluents. A certain grouping of species and varieties is characteristic of each biome. The biome or bioecological formation is based upon both plants and animals. Bioecology considers that plants and animals are inseparably united in the structure of any community.

There is a certain amount of verbiage in this definition. It describes a concept in terms that themselves may be difficult to define. However, Carpenter's paper cogently ties together a good deal of information about the biome and has the virtue of an excellent bibliography. The strength of the biome concept lies in that it recognizes a *bio*-ecology—a balanced evaluation of plant and animal interaction in nature. A weakness lies in that it has not actually done much to date towards developing this science.

In one of the strongest botanical papers Cain discusses the concept of climax communities. This paper is strong in that the author has taken pains (1) to view the climax with a well-rounded biological perspective; (2) to interpret carefully the opinions of various leaders in plant ecology, especially Clements, and (3) to provide the reader with an extended bibliography. The paper also deals at some length with a complex and esoteric terminology. To a zoölogically-minded reviewer this appears a debit. The reviewer, however, is vulnerable in making such a point since there is the very real danger that he may not fully comprehend the ideas expressed by the terms. Nevertheless, it is difficult to appreciate and sanction an intricate terminology when it seems to lack preciseness.

The final botanical paper by Gleason on the individualistic concept proved to be a stimulating theoretical essay. Gleason points out that there are three philosophical ways to view the plant association. In his words these are, (p. 93)

1. The association is an organism, or a quasi-organism, not composed of cells like an individual plant or animal, but rather made up of individual plants and animals held together by a close bond of interdependence; an organism, or quasi-organism with properties different from, but analogous to, the vital properties of an individual, including phenomena similar to birth, life, and death, as well as constant structural features comparable to the structures of the individual.
2. The association is not an organism, but is a series of separate similar units, variable in size but repeated in numerous examples. As such, it is comparable to a species, which is also composed of variable individuals. Under this view, the association is considered by some to be a concrete entity, merely divided into separate pieces, while by others the association as a whole is regarded as a mental concept, based on the common characters of all its separate pieces, and capable of typification by one or more of those pieces which most nearly approach the average or ideal condition.
3. The vegetation unit is a temporary and fluctuating phenomenon, dependent, in its origin, its structure, and its disappearance, on the selective action of the environment and on the nature of the surrounding vegetation. Under this view, the association has no similarity to an organism and is scarcely comparable to a species.

Gleason designates the last viewpoint as the individualistic concept which he implements in his paper. He concludes with the statement that, "The individualistic concept is totally at variance with the idea that the association is an organism, represented by many individuals, and also does not admit an analogy or homology between the species and the association." (p. 108)

An opposing theoretical position is taken by Emerson in a scholarly paper on social coördination. It is to the credit of the symposium leaders that both points of view were so ably represented. Following Spencer, Wheeler, Lloyd Morgan, Child and others, Emerson discusses at length the striking similarities, both ontogenetic and phylogenetic, existing between a complex social colony (*e.g.*, a termite nest) and an organism. On the basis of these analogies the social colony is designated a "superorganism"—an unfortunate term—and the thesis developed that it is of fundamental significance to view higher levels of biological association in this light. An interesting point emerging from Emerson's remarks is that the superorganism frequently becomes so highly integrated that *it* is the unit upon which selection operates and not the individual. For certain cases this seems incontestable.

I have no desire to contrast in any detail the philosophical aptness of the views expressed by Emerson and Gleason. Both have some evidence in their favor, and while personally I strongly subscribe to the idea that a population has a certain statistical uniqueness not possessed by an individual organism, I think the reader should decide for himself at what point this uniqueness becomes "social." Suffice it to say that these two papers are stimulating contributions, devoid of questionable terminology and suggestive of future investigations.

III

The strictly zoölogical efforts of MacGinitie, Eggleton, Tinbergen and Park were all essential in that they covered material of unquestioned importance for modern ecology. They were not, however, closely integrated and suggest by inference that animal ecologists are thinking along more diverse lines than are plant ecologists.

MacGinitie, in a critical and praiseworthy report, discussed littoral marine communities. The major point developed by this author was that a thorough and complete understanding of the individual life-history of each component of the community is essential in a study of any biocoenosis. MacGinitie's remarks were well tempered by the critical attitude. He expressed considerable doubt as to the value of much of the terminological type of research popular among ecologists today. His sound plea was for more work and less nomenclature.

Eggleton dealt with fresh-water aspects of ecology. His paper was essentially an outline of elementary textbook information about the scope and emphases of limnology. Since no points of general theoretical interest emerged, and, since the paper offered nothing particularly new either in organization or content this contribution was below the standard set by many of the other authors.

In an interesting paper on social coordination in birds Tinbergen reviews a good bit of material collected largely at his laboratory in Leiden. His basic problem parallels much of the work of Allee and Noble in this country. Tinbergen attempts to analyze minutely behavior responses between one bird, the "actor" and another, the "reactor." For many cases it is shown that the reactor responds specifically to a specific stimulus or signal produced by the actor. In sum, through careful observation it is demonstrated that many major behavior responses between two individuals may be described and frequently it is possible to predict what will happen if the actor offers a certain stimulus to the reactor. This is an instructive paper primarily because it suggests what can be accomplished by skillful observation. The paper is an addition to the symposium in the sense that it formally delineates an active field of research that has some ecological implications. However, there is no attempt made to relate the contents of the paper to wider ecologic principles. This is regrettable.

The final paper by Park attempts to survey the major developments of population research and to suggest how these studies may and do contribute to ecology. A brief review of statistical and experimental population phenomena based largely on work with microörganisms, *Drosophila* and *Tribolium* is followed by an attempt to relate these findings to the natural population and latterly to the

community. The paper is not too successful in the last part. The author is able to show that the laboratory studies yield data intrinsically interesting but the argument loses some of its cogency when applied to the analysis of community problems. However, it still appears that a closer wedding between the analytical and field disciplines will eventually materialize. There is a brief discussion of this paper by Doctor G. F. Gause of Moscow.

IV

In concluding, it would seem appropriate to take a final account of some of the issues raised in this volume. Obviously, the mere existence of the symposium, to be followed by the book, recognizes that there is a felt need for the coördination and formalization of ecology. This in itself is an important contribution. Happily, the contribution is further enhanced by the tenor of the papers which dealt with those aspects of ecological research that appealed to their authors as promising and significant. Differently put, the book is a good index of what progressive ecologists are thinking about. Such an index is particularly useful when it emphasizes, either by design or inadvertence, the errors and mistakes of ecology and recommends corrective measures. In places the book is good at doing just that.

The above then are the prime attributes of the Conference's published record. In my opinion they outweigh the less desirable features. However, the latter are present and must be mentioned briefly. The book fails to leave with the reader any consistent pattern into which ecologic concepts can be apportioned. There is no real coherency of the material presented and there are certain essential omissions. Ultimately ecology must cease to be a descriptive, qualitative science and become quantitative in character. Dealing with order and arrangement of biotic or group phenomena this seems completely inescapable. The present book is quite inadequate from this viewpoint. There are few places where a statistical approach is envisaged or even recognized. This is in no sense a specific criticism of the authors or the leaders of the conference. Rather it is a fault that must be laid at the doorstep of ecologists generally. The Cold Spring Harbor enterprise offered a splendid opportunity to encourage quantitative ecology. It is harder to criticize modern ecology on the ground that it is overemphasizing terminology. Such a criticism may be merely the personal bias of the reviewer. It does appear, however, that the Conference displayed a greater enthusiasm for terms than the present development of facts justify.

Other less major criticisms of the book may be enumerated. Most readers will probably feel that the printed discussions following each essay are so condensed and cryptic as to be practically valueless. This is one place where the book does the symposium an injustice. As the meetings the discussions were excellent. It is also unfortunate that the volume is poorly bound, lacks an index, and contains a number of typographical errors; since undoubtedly it will be contrasted to its disadvantage with the quantitative biology series. The latter are good examples of careful craftmanship.

In conclusion it is worth restating the opinion earlier expressed that, despite obvious faults, *Plant and Animal Communities* is a thought-provoking, timely, stimulating and moderately critical book. It deserves a place in the library, and more importantly in the thinking, of all well-read biologists.

BRIEF NOTICES

EVOLUTION

LIFE'S BEGINNING ON THE EARTH.

By R. Beutner. Williams & Wilkins Co., Baltimore. $3.00. 9 x 6; x + 222; 1938.

The belief in the spontaneous generation of living matter from inert matter has perhaps always been more widespread than is commonly realized. From Vergil's account of bees down to the modern country-side superstition about horsehairs and snakes ordinary people have found little difficulty in accepting this theory.

The modern exponent of spontaneous generation bases his belief not on empirical but on rational grounds. On the premises

of cosmic philosophy he argues that when the earth came into existence its condition was such that water could occur only in the form of steam, making impossible the existence of any form of life now known to us. Therefore, when life finally appeared, it must have been spontaneously generated. This conclusion is not unassailable, for it takes no cognizance of the theory of panspermia advocated by Haeckel and Arrhenius, that living matter may have come to the earth from intersteller space. And the logic by which it is reached, while sound, is nevertheless only logic, and he who uses it is arguing not as a scientist but as a philosopher.

Yet there is quite a large body of evidence in support of the theory of spontaneous generation which is presumptive even if circumstantial. The book under review is a discussion of this evidence.

The reader on finishing it is likely to be surprised at the great amount of experimentation that has been performed within the past few years in the way of imitating the structure and activity of living matter, also at the great resemblances between artificial "plants" and their living prototypes, as brought out by the many excellent illustrations with which the book is provided. Incidentally, the caption under one of the illustrations designates the plant shown as a cactus, which it obviously is not. The reader is also likely to have the feeling that despite the wealth of material compressed between the covers of this book all that the author has really accomplished is the identification of the dynamics of living matter with that of inert substances. The statement on the cover about bridging the chasm between the two kinds of matter seems a bit premature. The fundamental question as to the origin and nature of life seems destined to remain unanswered for a long time to come.

There is no index to the book, but the orderly and systematic arrangement of its subject matter makes one unnecessary.

THE EVOLUTION OF GENETIC SYSTEMS. *By C. D. Darlington. The University Press, Cambridge; The Macmillan Co., New York.* $2.75. 8¼ x 5¼; x + 149; 1939.

It would have been well could this book have been expanded to between three and four times its present bulk. The author has been so economical with words (apparently a characteristic of modern scientific literary style) that his meaning is quite obfuscated. This is unfortunate, as the book is extremely scholarly and quite significant.

The bibliography contains 74 items, of which 55, or more than half, have appeared during the past five years, showing that the author's conclusions are based on absolutely the most recent research. Perhaps the most important part of the work deals with the evolution of sex. It is well known that the sex chromosomes of all animals are not homologous with each other, but it is not so well known that some of them may be homologous with somatic chromosomes of other animals. In other words, chromosomes undergo changes of function with evolution just as somatic structures do. It is obvious that this must be the case, for new chromosomes must be derived from old ones, but observed instances of it are not plentiful.

To anyone who wished to keep posted on the most recent developments in genetic theory this book will prove indispensible, but such a use of it is only incidental to the author's intention. To him the genetic theory is much more than a hypothesis—"it is the key with which the door between the physical and biological sciences is being opened." But the more catholic devotee of science for whom this book obviously is intended is likely to have trouble getting the key into the keyhole.

The index covers eleven pages.

THE APE IN ANTIQUITY. *The Johns Hopkins University Studies in Archaeology, No. 27. By William C. McDermott. The Johns Hopkins Press, Baltimore.* $5.00. 9⅛ x 6; xi + 338 + 10 plates; 1938.

This is a very unusual book. It deals not with apes *per se*, but with what men through the centuries have thought about apes. The author has gathered his material from two kinds of sources—on the one hand, representations on artifacts and figurines, chiefly from the Mediterran-

ean basin, but also from Egypt, Mesopotamia, Persia, India, China, and even the New World; and on the other hand, references in ancient literature, not only the classics but also many obscure documents.

In view of the controversy that raged during the latter half of the nineteenth century as to whether or not man was descended from the apes it is interesting to note that in the pre-Christian era the opposite view was widely held—that apes were degenerate men of a race called the Cercopes whose name is perpetuated today in that of *Cercopithecus*. The mythical home of these people was located on the island of Ischia, which in ancient times had three names, derived respectively from Greek, Arabic, and Egyptian roots, all of which meant "ape." It is interesting to speculate as to whether the name Ischia itself may not be connected with the ischial callosities which constitute such a conspicuous topographical feature of the baboon. The Barbary ape became established on the rock of Gibraltar in the second century. The first civilized person to see an anthropoid in its native habitat was Hanno, the Carthaginian, in the sixth century B.C. Yet more than a thousand years before Hanno a knowledge of apes had become widely disseminated among the Europeans, as a result of their commercial intercourse with the Egyptians.

The footnotes are numerous, averaging more than five to the page throughout the book. Nearly all of these are bibliographic references, which would have improved the book could they have been set out in the text, as many of them come from works not readily available. The bibliography itself is painfully brief—perhaps with such an extensive documentation a bibliography is not necessary. There are twelve pages of index, and the plates are photographic.

STRATIGRAPHY AND PALEONTOLOGY OF THE LOWER MISSISSIPPIAN OF MISSOURI. Part I. *The University of Missouri Studies, Volume XIII, Number 3, 1938.*

By E. B. Branson. University of Missouri, Columbia. $1.25. 10½ x 6¾; vii + 205 + 20 plates; 1938 (paper).

The stratigraphy and paleontology of the Chouteau and Glen Park limestones, and the Bushberg sandstone of Missouri are described in this first part of the study of the fossil fauna of the Lower Mississippian. The Chouteau fauna is dominated by brachypods, with the following forms occurring in the order given—bryozoans, crinoids, pelecypods, worms, corals, gastropods, cephalopods, blastoids, trilobites, fishes including conodonts, ostracods, sponges, and foraminifera. (This estimate is based on probability of being able to collect specimens and not on number of genera or species.) The genera that are lacking in the Glen Park region are significant; no *Avonia*, *Productus*, or *Pustula* is present, although all are abundant in the Chouteau, Bushberg, and Lower Mississippian formations in all parts of the United States. Spiriters are rare: the crinoid generic identifications are not even provisional, but impossible on the basis of the fragmentary material. The fish fauna of the Bushberg other than conodonts includes 12 species belonging to seven genera. The invertebrate fauna has been found in only one place.

Twenty plates, exhibiting from 13 to 43 well-executed figures are included in this study; also maps and illustrations of rocky formations. Part II, the next number of the *Studies* will complete the survey.

PREHISTORIC LIFE.

By Percy E. Raymond. Harvard University Press, Cambridge. $5.00. 9¾ x 6¼; ix + 324; 1939.

All too often a student's introduction to paleontology is a fleeting one, included in a beginning survey of geology. Such an introductory survey may be as marvelous as the circus and just as stimulating to the beginner, but paleontology is not a side-show. It is a menagerie which includes as many rings and stages as any other circus.

For the past seventeen years Professor Raymond has been offering at Harvard a course under the title of Paleontology I. This book is the essence of his constantly changing series of lectures, presented to twenty-five classes of students. Professor Raymond's teaching is at once ortho-

dox and heterodox: orthodox in that it tells a conventional story, but heterodox in part, as the author explains, whenever it reflects only his personal views. Insofar as possible Professor Raymond has related the changing forms of prehistoric life to their changing environment. He succeeds in giving his subject a dynamic turn.

PRINCIPLES OF PALEOBOTANY.

By William C. Darrah. Chronica Botanica Co., Leiden; G. E. Stechert and Co., New York. Guilders 7 or $4.00. 9¾ x 6¼; [6] + 239; 1939.

Beginning with short chapters on the history and aims of paleobotany and the techniques employed in its study, the author progresses from the earliest of plants, the Psilopsida, to the present day floras. The more advanced Devonian floras, consisting of the Lycopsida, Sphenopsida, and Pteropsida, are all carefully reviewed. The remaining fossil plants from the late Paleozoic, the Mesozoic and Cenozoic eras are discussed in chronological order. Other problems such as the the origin of the angiosperms, floral changes in spatial distribution, and the origin of existing floras form the remainder of the discussions presented in this book. The writer concludes with a chapter on the relationship of these plants. Altogether this constitutes a fine presentation of the present knowledge of paleobotany.

DIE STAMMESGESCHICHTE DER WIRBELLOSEN TIERE IM LICHTE DER PALÄONTOLOGIE.

By Oskar Kuhn. Verlag von Gustav Fischer, Jena. RM. 6. 9½ x 6½; vi + 130; 1939 (paper).

This is a comprehensive report of factual data on invertebrate phylogenies based on paleontological findings. The author divides the invertebrates into seven groups. There are many excellent illustrations and charts on phylogenetic histories. No bibliography is appended since all sources are mentioned as they appear in the text. *Zur Stammesgeschichtes der Insecta-Pterygota* by H. Haupt follows the monograph by O. Kuhn.

Kuhn's previous paleontological study of the phylogenetic histories of the vertebrates was reviewed in Vol. 14, No. 2 of Q.R.B.

GENETICS

THE AMERICAN SPECIES OF CREPIS. *Their Interrelationships and Distribution as Affected by Polyploidy and Apomixis. Carnegie Institution of Washington Publication No. 504.*

By E. B. Babcock and G. L. Stebbins, Jr. Carnegie Institution of Washington, D. C. $3.00 (cloth); $2.00 (paper). 10 x 7; 199 + 2 folding charts; 1938.

The taxonomic complexities of the genus *Crepis* (hawksbeard) are the result of the processes of polyploidy, hybridization, and apomixis which these plants have undergone in their evolutionary formation. In distinguishing the species the writers have taken three criteria into consideration: morphological likeness or distinctiveness, the degree of genetical isolation, and the degree of similarity in the evolutionary history of the components of the species.

The American group of *Crepis* probably originated by allopolyploidy from hybrids between 4- and 7-paired species of the Old World. After the original 11-paired species were formed in this country, they began to produce the higher, apomictic polyploids, and the formation of these has continued to the present time, greatly displacing the diploid forms. All the species of *Crepis*, including subspecies and apomictic forms, are described. There are keys, distribution maps, and drawings of involucres and achenes to help in their identification. This work constitutes a neat and valuable study of a difficult group demonstrating how genetics and cytology can clear up abstruse problems of relationship, evolution, geographic spread, etc.

VERERBUNG "ERWORBENER EIGENSCHAFTEN" UND AUSLESE.

By Walter Zimmermann. Gustav Fischer, Jena. RM. 17. (paper); RM. 18.50 (cloth). 10¼ x 6¾; xii + 345; 1938.

The author, a botanist, deals with the

old and much discussed problem of the heredity of acquired characters (in 12 chapters) and presents at the end a large amount of literature drawn from many fields of science and philosophy. In the last section he reaches, in addition, some practical conclusions, especially regarding the origin and phylogenetic development of man. In the author's opinion, "heredity of acquired characters" is only possible insofar as organisms are able to acquire new qualities by changes of genetic factors and thus to transfer them to their offspring. But there is no "heredity of acquired characters" in the sense that personal changes of body and intellect cause a corresponding change in the genes. What conditions induce the hereditary change are in most cases unknown. As far as we know the stimulation from outside must directly affect the genes. The accumulation of favorable adaptations in phylogeny has come about by the continued selection of the fittest, in the sense of the classical theory of selection of Darwin.

ERBLEIDEN DES AUGES. *Handbuch der Erbkrankheiten. Band 5.*

By Max Bücklers, Wilhelm Clausen, Bruno Fleischer, Heinrich Harms, Adolf Jess, Walther Löhlein, Oswald Marchesani, Wolfgang Stock, Wilhelm Wegner. Georg Thieme Verlag, Leipzig. RM. 26 (cloth); RM. 24 (paper). 10 x 6½; xi + 310; 1938.

All the different eye diseases are systematically dealt with from the point of view of heredity by a number of eye specialists. Thus Bruno Fleischer deals with inborn deformities; Walther Löhlein with glaucoma in childhood, and glaucoma of adults; Wolfgang Stock with microcornea and macrocornea. Max Bücklers treats in detail the opacities of the cornea, hereditary changes of the position and form of the lens, and hereditary opacities of the lens; Oswald Marchesani deals with albinism, total and partial color-blindness; Adolf Jess with pigment degeneration of the retina, inborn night-blindness, and some other hereditary diseases of the retina (glioma, neuro-epithelioma retinae, etc.). The refraction anomalies are presented by Wilhelm Clausen, squinting and hereditary motor disturbances of the eye by Heinrich Harms. Consideration is always given to the literature at the close of the single chapters.

PRINCIPLES OF GENETICS. *Third Edition. By Edmund W. Sinnott and L. C. Dunn. McGraw-Hill Book Co., New York and London.* $3.50. 9 x 6; xiv + 408; 1939.

Six years have elapsed between the second and third editions of this book (cf. Q.R.B., Vol. 8, p. 103). Considerable revision has been done, particularly in the latter half of the volume, in order to include new material and many new illustrations in the text without increasing the size of the volume. The basic method of treating the subject has not been radically changed. A new chapter on cytoplasmic inheritance has been added and elementary biometric methods have been briefly and simply treated in the section dealing with multiple factor inheritance.

GENERAL BIOLOGY

I KNOW AN ISLAND.

By R. M. Lockley. George G. Harrap and Co., London, Toronto, Sydney and Bombay. 10s. 6d. net. 8½ x 5⅜; 300 + 33 plates; 1938.

This is a book of birds and islands and is written by a man who lives with his wife and daughter on the otherwise uninhabited island of Skokholm off the coast of Pembrokshire. Skokholm "had lain derelict for at least twenty years" before the author leased it and transformed the deserted Welsh island into a snug, comfortable home. In the first and last chapters of the book the author tells of his desire to live on an island sanctuary, of his search and discovery of the ideal place, of the history of Skokholm from the ninth century to its present occupation, and of the years which he has spent there with his family. The remaining chapters deal with the author's visits to other islands, such as Grassholm, Ramsey, Bardsey, the Blaskets, Heligoland, Fair Isle, North

Ronaldshay, the Faeroes, and the Westmanns. There is scarcely a page in the book which does not mention the profuse bird-life which he found everywhere and there are fascinating descriptions of puffins, razorbills, storm-petrels, guillemots, gulls, shearwaters, gannets, the rare Leach's fork-tailed petrel (found by the author on Sudurey in the Westmanns), and others too numerous to mention.

Although the author's paramount interest is bird-life, his colorful accounts of islanders show a keen understanding of human beings also. He points out how little contact many of these people have with the rest of the world and how little interested they are in outside affairs. There is the story of an old Blasket Island man who, speaking of a former islander, said, "He was the only man in Blasket who went to England's war with Germany and in my opinion he was always a half-mad man."

This is a simply and beautifully written book, well illustrated by photographs and maps.

ESSAYS IN PHILOSOPHICAL BIOLOGY.

By William Morton Wheeler. Selected by G. H. Parker. Harvard University Press, Cambridge. $3.00. 8 x 5⅜; vi + 261; 1939.

In a foreword, Professor Barbour explains that the twelve essays by the late William Morton Wheeler presented in this volume have been reprinted for two reasons. First of all, most of them are out of print, and secondly, "these essays are unique in the history of American Biology." All will agree that the latter is the much more important reason and Professor Parker deserves the thanks of all biologists and scientists for the task he has so well undertaken. The selected papers are arranged in chronological order from that entitled: *The Ant-colony as an organism*, printed in 1911, to that published in 1934 under the title: *Animal societies*. Included are also our favorites: *The termitodoxa, or biology and society; The dry-rot of our academic biology; Emergent evolution and the development of societies*. Words of praise or comments on the essays would be entirely superfluous. They are veritable gems of scientific literature, familiar to students of biological sciences who will welcome the opportunity to have them gathered here. Included is also a biographical sketch of Wheeler written by L. J. Henderson, Thomas Barbour, F. M. Carpenter and H. Zinsser.

WILD COUNTRY. *A Highland Naturalist's Notes and Pictures.*

By F. Fraser Darling. The University Press, Cambridge; The Macmillan Co., New York. $2.75. 9 x 6¾; vii + 104; 1938.

This is essentially a picture book, but a superb one. Fraser Darling is rapidly emerging as the world's leading field naturalist. He has the same zest really to live with raw nature and see what goes on that characterized his great predecessors in this now largely outmoded part of biology. The physical and social hardships that such a career necessarily involves are taken in stride. But beyond all this, and vastly more important, Fraser Darling brings to his work what none of the older field naturalists did in anything like the same degree—the rigorous critical attitude of the laboratory in the study of the behavior of unrestrained animals in their undisturbed natural surroundings.

The present volume demonstrates that, along with his observational and scientific penetration, Darling as a nature photographer has had few equals and no superiors. Every biological laboratory, private as well as institutional, must have this book on its shelves.

SAGA OF THE "DISCOVERY".

By L. C. Bernacchi. Blackie and Son, London and Glasgow. 10s. 6d. net. 8½ x 5½; xv + 240 + 48 plates + 2 maps; 1938.

The famed walrus in *Alice in Wonderland* was no more versatile in his talk than is Mr. Bernacchi. In telling of his own and subsequent adventures in the Antarctic wonderland, the latter gentleman does fail to mention cabbages, but this is compensated for by interesting comments on the lack of other greenery and fresh foods.

Since knowledge of vitamins was nil during the period when the Discovery was icebound, scurvy was as great an impediment to exploration as were storms and crevasses.

Although the tale of joys and hardships of this land of pioneers is an entertaining one, the biologist finds the latter half of the book of greater interest. This describes biological research expeditions into frigid seas, with particular reference to the problem of conservation in whale fishery. The behavior of seals, penguins, petrels, and skua gulls enters for its share of narration, with sidelights on the smaller animals and plants on which they feed. Throughout the volume maps and excellent photographs clarify the description.

NEW ENGLAND NATURALIST. *The Magazine of the New England Museum of Natural History, Number 1.*

Boston Society of Natural History. New England Museum of Natural History, Boston. 25 cents. 10¼ x 7½; 20; 1938 (paper).

This journal is the new organ of the New England Museum of Natural History, and is intended to replace the earlier *Bulletin*. The first number is 21 pages in length, and contains 9 short articles of general interest in the field of Natural History; an announcement for special courses in nature study for Scout leaders given by the Education Department of the Boston Society of Natural History; an obituary of John Charles Phillips (1876–1938) who was a trustee of the Society (1915–1936); a list of new members and a list of new publications of the Society. The journal is well printed and generously supplied with illustrations. It should be an interesting and valuable addition to the library of any society or institution which has an active interest in the natural history of the fauna and flora of our New England states.

BIBLIOGRAPHY ON SOIL EROSION AND SOIL AND WATER CONSERVATION. *U. S. Department of Agriculture. Miscellaneous Publication No. 312. Compiled by Stanley H. Gaines, with Abstracts by Francesca Vincent, Marion Bloom, and James F. Carter. Government Printing Office, Washington.* 60 cents. 9¼ x 6; 651; 1938 (paper).

This bibliography, arranged under 31 general headings, is by no means confined to references to the United States, although these make up by far the larger part of the citations. Many other regions are included so that practically all types of geographic areas are represented.

The purpose of the bibliography is primarily to provide authors, subject-matter specialists, and students with a medium by which they may determine, with a minimum of time and effort, what others have written on a given related subject, whether it be scientific or historic in nature or merely indicative of the trend of public opinion. Consistent therewith, references to both popular and scientific material are included.

The abstracts, which accompany the references "are intended to amplify ambiguous titles, and in many cases, it is hoped, to serve the final purpose of the user of the bibliography." The authors' index, which covers 52 closely printed pages, gives some indication of the ground covered.

AN INTRODUCTION TO LABORATORY TECHNIQUE.

By A. K. Ansley. With a Foreword by F. H. Newman. Macmillan and Co., London and New York. $4.50. 8½ x 5½; xiii + 313; 1938.

A useful book to have in the reference section of all science libraries. It deals with "various techniques employed in the many processes and methods used in laboratory maintenance." A few of the chapter headings will serve to give the reader the scope of the book: The care of laboratory equipment; Cements, lutes and solvents; Electric motors; Glass-blowing and glass-working; Insulators and their working; Optical projections of lantern slides; Storage cells; etc. In the appendix there is a section on first aid treatment for laboratory workers, and also a number of tables in which are given data on such subjects as densities of common substances, physical constants of the elements, conversion tables, etc. The volume is somewhat briefly indexed.

PLINY. NATURAL HISTORY. *With an English Translation. Volume I. Praefatio, Libri I, II. Loeb Classical Library.*

By H. Rackham. Harvard University Press, Cambridge; Wilhelm Heinemann, London. $3.50 (leather); $2.50 (cloth). 6½ x 4; xiv + 378; 1938.

In the introduction the author presents a brief biographical sketch of Gaius Plinius Secondus (Pliny the Elder) and a summary of the contents of Pliny's Preface and Books I and II of Volume I. The Latin text appearing in this book is printed from that of Detlefsen, Berlin, 1866, and checked by the Teubner edition of Ludwig von Jan re-edited by Karl Mayhoff in two volumes, 1905, 1909.

A splendid addition to the long list of scholarly publications of the Loeb Classical Library.

FUNDAMENTALS OF BIOLOGY, *Animal and Plant.*

By William C. Beaver. C. V. Mosby Co., St. Louis. $4.50. 8½ x 5½; 896; 1939.

The early chapters of this voluminous and comprehensive work are devoted to fundamental biological properties. Both plant and animal biology receive treatment, representative forms of twenty-eight animals and fifteen plants being compared anatomically and functionally in their respective systems. Genetics and evolution are briefly represented, as are the biochemical and biophysical phenomena involved in physiological processes.

An excellent feature of this book, not duly stressed by the average text, is the demonstration of the practical value of the study of biology. This is brought out by showing the applications to agriculture, fuel, conservation, medicine, and other aspects of human welfare. Although the drawings are artistically poor, there is an extensive glossary and a good index.

ETUDE MORPHOLOGIQUE ET BIOLOGIQUE SUR LES FLAGELLÉS INTESTINAUX PARASITES DES MURIDÉS. *Etude comparative des Flagellés du Cobaye.*

By Léon Morínas. Masson et Cie, Paris. 60 francs. 9¾ x 6½; 234; 1938 (paper).

After describing his techniques and giving a list of the organisms found, the author presents his results, together with data obtained from the literature, on the morphology and biology of the intestinal Flagellata of rats and guinea pigs. The biological part includes studies on ecology and conditions determining parasitism, such as the pH of the intestinal tract, diet regime, and floral bacteria of the hosts. The bibliography of 14 pages is listed under the headings morphology and biology. There is no index.

BIOLOGICAL SURVEY OF THE MOUNT DESERT REGION. Part VI. *The Insect Fauna with references to methods of capture, food plants, the flora and other biological features.*

By William Procter. Wistar Institute of Anatomy and Biology, Philadelphia. Free. 10 x 6¾; 496; 1938.

Mount Desert Island occupies an interesting location between the Boreal and Transition zones. The biota consequently includes species typically found in northern or southern latitudes. The insects and spiders from the island are herein listed. While the list is admittedly not complete, it still remains a formidable one considering the area of the island that was surveyed. The index to the forms listed covers something over 30 pages.

SYMBIOSE DER TIERE MIT PFLANZLICHEN MIKROORGANISMEN. *Sammlung Göschen, Band 1128.*

By Paul Buchner. Walter de Gruyter and Co., Berlin. RM. 1.62. 6¼ x 4½; 123; 1939.

This little book, an addition to the well-known *Göschen* series, is an authoritative introduction, for the layman as well as student, to the symbiotic life of land and water animals with plant microorganisms. It is supplied with illustrations, a bibliography, a glossary of terms, and a subject index.

UNIVERSITY OF COLORADO STUDIES. *General Series No. 423. University of Colorado*

Bulletin, Volume 26, Number 1. Containing: *Studies of Island Life*, by Theodore D. A. Cockerell; *Abstracts of Theses and Reports for Higher Degrees.*

University of Colorado, Boulder. $1.00. 10 x 6¾; 188; 1938 (paper).

HUMAN BIOLOGY

THE AMERICAN CRIMINAL. *An Anthropological Study. Volume I. The Native White Criminal of Native Parentage.*

By Earnest A. Hooton. With the collaboration of the Statistical Laboratory of the Division of Anthropology, Harvard University. Harvard University Press, Cambridge. $10.00. 10½ x 7¼; xvi + 309 + [493]; 1939.

CRIME AND THE MAN.

By Earnest A. Hooton. Harvard University Press, Cambridge. $3.75. 9¼ x 6; xvi + 403; 1939.

The bitter attacks against the Lombrosian ideas of a criminal man have been mainly from two sources. The first being represented by those penologists with a Messianic complex and the second by anthropologists and criminologists who have pointed out the obvious defects in the factual foundations of Lombroso's assertions. Through the efforts of the latter group, the theory of atavism has been rejected and strong doubts have arisen regarding the existence of criminal stigmata. The final blow was apparently struck by Goring who denied that criminals were differentiated at all physically from non-criminals. But, Goring's work although utilizing refined statistical methods has a number of flaws, not the least important being his preconceived notions on the subject. Hooton, among others, noted these defects and determined to reexamine the whole question. For over a decade, he and his associates have conducted an extensive anthropometric survey of the prison population in various sections of the country. In total, almost 11,000 male prison inmates in 10 selected states were measured as well as a small control group of about 300 civilians obtained in two of the states (Massachusetts and Tennessee). Some twenty odd measurements concerning body, head and ear dimensions were taken on each subject and in addition observations regarding hair, skin, shape of head, ears and face were made. The results of the elaborate analysis of these data are presented in a technical series of volumes, the first of which is noted here, and in the semi-popular book which is also discussed in this review.

The first volume of the technical series is concerned with more than 4,000 white criminals, native born of native parentage. After making the necessary corrections for differences between states and between observers the main conclusion reached is that criminals as a group demonstrate physical as well as educational inferiority when compared to the civilian population. This is particularly true and found to a greater degree for recidivists. Moreover, Hooton finds that when criminals are classified according to body type there seems to be some association between physique and type of crime committed, as, for example, stocky build with sex and assault crimes, slender and short persons with larceny. The data also indicate that the criminals, as a group, have decreased pilosity, extreme variation in types of ear protrusion, preponderance of low and sloping foreheads.

These results are summarized in the book entitled *Crime and the Man* which includes also an outline of the results derived from the study of foreign born criminals, native born of foreign parentage and of Negroes. All the evidence points to the same direction, that on the whole the criminal is organically and physically differentiated from the general population. The author, therefore, suggests a reorientation of penology and criminology that will give due weight to the biological factor in crime.

Crime and the Man is written in an amusing vein with many ironic sarcastic shafts directed at certain groups of penologists. The layman will find it interesting and enjoyable not only because of its style but also for the unusual illustrating cartoons it contains. The first volume of the technical series is, of course, well written but the statistical information is not summarized in the clearest possible fashion. Neither volume contains any indication

of the great amount of literature, some good, some bad, that has accumulated in the years since Lombroso and Goring.

THE PASSING OF THE ABORIGINES. *A Lifetime spent among the Natives of Australia. By Daisy Bates. Foreword by Sir George Murray and an Introduction by Arthur Mee. John Murray, London.* 10s. 6d. net. 8¼ x 5½; xviii + 258 + 12 plates; 1938.

Two civilizations cannot simultaneously occupy the same habitat. When the first European stepped upon Australian soil the doom of the aborigines was sealed. Just as the rabbit is supplanting the kangaroo and the sparrow the kookaburra so will it be only a question of time until the bush man vanishes into Kur'an'nup beyond the western sea, and the only choice that confronts the white man is as to whether his paleolithic brother shall be exterminated with kindness or cruelty. The one method is as efficacious as the other.

Rumors of the latter as long ago as 1899 impelled an Anglo-American periodical to send Mrs. Bates to Australia to make an investigation. Her observations led her to believe that whatever cruelty with which the Aborigines might have been afflicted was generally unconscious and always unofficial.

But Mrs. Bates' task was only beginning when she had completed her investigation of these rumors. For the next thirty-five years she remained living with these primitive people, ministering to their needs, helping them settle difficulties, and mediating in disputes between different factions, for unfortunately there is a great deal of intertribal jealousy in the bush. There are two distinct genealogical stocks represented, the dominant one having entered Australia only a few short centuries before the advent of the Europeans. Between these two there existed a condition of perpetual strife, and within each was a highly developed caste system with innumerable taboos that precluded any sort of amity.

The author, now 78 years of age, has recently returned to civilization to analyze and interpret the great quantity of anthropological data which she has accumulated. This will be for the basis of another report. The present work, while it contains much of an anthropological nature is primarily an account of her personal contacts with these people. Her associates in the bush were not attractive, judged by western standards. They were frankly cannibalistic, the women often eating the children which they bore to the dissolute whites to whom their black husbands had leased them, and not infrequently their pure blooded children as well, because they had a better flavor; the men who could not support all their wives devoured the superfluous ones, all sorts of cruelty were commonly practised and they never bathed, yet withal there were some outstanding individuals among them who showed strength of character in their own way.

WHITE SETTLERS IN THE TROPICS. *American Geographical Society. Special Publication No. 23. By A. Grenfell Price, with additional notes by Robert G. Stone. American Geographical Society, New York.* $4.00. 10 x 6¾; xiii + 311 + 20 plates; 1939.

The problem of the fitness of the tropics for white settlement has drawn the attention of many students, especially in recent years, when a number of very timely contributions have appeared. It is just a year and a half, for instance, since a group of American workers under the leadership of Isaiah Bowman prepared a unique report, world-wide in scope, on the present limits of land settlement. This report was sponsored and published by the Council on Foreign Relations. And now comes another comprehensive synthesis, this time one which is devoted solely to the *tropics* and to *white* settlement. The author was interested particularly in the more scientific attempts to invade the tropics. Specifically, he wanted answers to the questions, why have white settlements failed in the past, and can they be expected to succeed in the future?

Working primarily in Australia, but also in Africa, in South America, in Panama, in the Caribbean, and in Florida,

Price set out to appraise as precisely as possible the measurable factors governing white acclimatization in selected areas and regions. The information collected from many types of white settlement has been recorded in this book. With the aid of modern technology certain white settlements seem to have achieved remarkable success. Yet Price does not offer much hope that the political outcasts from Central Europe will be able to find satisfactory homes in the tropics. His conclusion is the one to which all competent students of the problem seem to come, no matter how they approach the question. Except in certain marginal zones debilitating heat, disease, isolation, and competition with colored races of a lower standard of living stand as barriers to permanent white settlement.

This book comes forth under the auspices of the American Geographical Society, for whom it was edited by J. K. Wright, the author being in Australia. At the request of the Society, Mr. Robert G. Stone of the Blue Hill Meterological Observatory, Harvard University, has contributed some additional data in the form of notes, especially bibliographical references, and some appendices on the results of modern physiological research in relation to human acclimatization in the tropics. The imprint of the American Geographical Society is a sufficient recommendation of the book. The Society's "special publications" are invariably outstanding.

AFRICAN WOMEN. *A Study of the Ibo of Nigeria.*

By Sylvia Leith-Ross. Foreword by Lord Lugard. Faber and Faber, London. 15s. net. 8½ x 5½; 367 + 8 plates + 2 maps; 1939.

Practically all the knowledge about the behavior of primitive women has been acquired by male observers, but the investigation reported here has been conducted by a woman and one, moreover, who has lived a good part of her life in Nigeria. The Ibo, whom she studies, are said to number over 3 millions and are mainly agricultural. While their contact with European civilization has been limited to missionaries and British officials only, they apparently are already lacking in the rigid set of conventions and traditions so common to primitive peoples. All told, they seem to be a practical and intelligent people and this is manifest especially in the social relations between the sexes. The women participate actively in the agricultural work and in the trading derived from it. They work the fields toward which they assume exclusive proprietory feelings. They conduct trading and are predominant in the market places. As a result they are regarded as true helpmates by the husbands who take great pride in the accomplishments of their wives and allow them overt expression in community affairs. The most striking feature of this custom is that a sense of solidarity has developed among the women to a greater degree than among the men. So much so that a few years ago the women were able to stage an actual riot in protest against the taxation demanded by the British authorities. The description of the customs of the Ibo women is the central theme of the book but the author has added acute observations on the reactions of this group to the missionaries and to the customs of the European. These accounts are very amusing even though they reflect on the intelligence and the reform complex of the white man. Scattered throughout this work are many observations dealing with items of general interest to the human biologist. Aside from its scientific value the book will be found enjoyable for the style in which it is written. One point that might be criticised is the emphasis on the degree of equality given to the Ibo women in comparison to that noted among European and among other primitive peoples. As a matter of fact, it is realized that ethnologists have been guilty of some misinterpretations in this respect. Moreover, the author will find many of the customs she describes on this point common to white populations engaged in agriculture as, for example, among the Southern European groups.

ATLANTIC CIRCLE.

By Lord Moyne. Photographs by Lady Broughton. Blackie and Son, London and

Glasgow. 18s. net. 8½ x 5½; xii + 201 + 80 plates; 1938.

This is an interesting story well told. The author is the owner of a 200 foot yacht, and interested in all departments of natural science. For the better part of three years he and a group of congenial companions have circumnavigated the North Atlantic Ocean, in which they played a part similar to that of the Hancock Ensemble in the Pacific. The present work covers the personal phase of their experiences—the complete report of their archaeological, anthropological, and biological accomplishments cannot be made available without about a year of further study.

The author, being an Englishman, naturally writes from an English viewpoint and has English readers in mind. He expresses surprise at the magnificence of the Maya ruins in Middle America and regrets that they are not as well known as those of Egypt. This was the condition once, but the progress made by American archaeology in the past two generations makes it no longer so today. Perhaps the most interesting part of the book is that which deals with Greenland. Denmark has exhibited unusual intelligence in its policy toward Greenland. Although much pressure has been brought upon the Danes to open Greenland up for settlement and exploitation, so far the Danish government has remained firm and admits visitors only under great restrictions, and settlers not at all. The result is that Eskimos and Greenlanders are slowly increasing in population. We are told that the Eskimos are not brachycephalic as their physiognomies would seem to indicate, but have true dolichocephalic skulls. Their brachycephalic appearance is due to the heavy musculature of the jaw, which they develop by chewing the walrus hide and sealskin from which they make shoes and clothing in order to soften it.

A chapter on marine biology written in popular style concludes the book, and there are seven pages of index. The illustrations are from photographs, and their excellence makes the reader regret that they are not more numerous.

THE SEX CRIMINAL.

By Bertram Pollens. Foreword by Richard A. McGee. The Macaulay Co., New York. $2.00. 8 x 5½; viii + 211; 1938.

The author regards society's present understanding of the sex criminal as at about the same stage as was its attitude toward the insane many years ago. "The sex criminal is not possessed of the devil and sending him to the electric chair or imprisoning him will not cure him nor will it deter others from becoming sexual psychopaths." The present incompetency of the law in the treatment of sexual offenses is deplored.

> In the first place, we must discard the traditional legalistic attitude which takes into account only the actual act performed by the 'criminal,' and which classifies these acts into misdemeanors and felonies with commensurate punishments for each. Thus, according to our present law, one who 'indecently fondles' a little girl is guilty of 'impairing the morals of a minor,' and is guilty only of a misdemeanor punishable by a short prison term. Whereas one who has sexual intercourse with a girl seventeen years of age, with her consent, who may even be a prostitute, is guilty of rape, a felony, and may be sentenced to a long term in state prison. Actually, the first is far more dangerous than the second. In both cases, moreover, the actual acts performed are not as important as the motives underlying these acts and the psychological state of the individual performing these acts.

In this excellent study the author, senior psychologist in the sex clinic in the Rikers Island Penitentiary of New York City, and trained in law as well as in psychology, draws from his large experience and accounts of the more publicized 'sex murders' in presenting many case histories of 'minor' as well as 'major' crimes, dividing the material on the bases of infantile sexuality, homosexuality, latent sexual deviations, and accidental sex offenses. He shows not only the background of this type of criminal, but the prognosis of what he might develop into and methods of curbing him. Statistics are presented, the increases not necessarily meaning that more such crimes are now being committed, but rather that there is greater publicity or a more thorough reporting of these misdemeanors. The book contains a few references in the foot-notes, but otherwise there is no bibliography.

LAND UTILIZATION IN CHINA. *A Study of 16,786 Farms in 168 Localities, and 38,256 Farm Families in Twenty-two Provinces in China, 1929–1933. In 3 Volumes. Vol. I, [Text]; Vol. II, [Atlas]; Vol. III, [Statistics].*

By John L. Buck. University of Chicago Press, Chicago. $15.00 for the three Volumes. Vol. I, 9 x 6 ; Vols. II and III, 17½ x 12⅛; Vol. I, xxxii + 494 + 28 plates; Vol. II, xii + 146; Vol. III, xv + 473; 1937.

An important survey which was started over ten years ago. Its purpose was threefold; "first, to train students in the methods of research in land utilization; second, to make available knowledge of China's agriculture, for its improvement, and as a basis of national agricultural policies; and, third, to make available to people of other countries interested in China's welfare certain elementary information about land utilization, food, and population in China." We regret that these volumes must be treated so briefly. Dr. John Lossing Buck, Professor of Agricultural Economics at the University of Nanking, directed the survey, was assisted by a large group of Chinese and a number of Americans. The work was first supported by the China Council and later by the International Research Committee of the Institute of Pacific Relations which appropriated, from funds given by the Rockefeller Foundation, a series of grants. Contributions to cover expenses of publication have been made by the National Economic Council, and the Central Bank of China.

The first of these volumes is divided into the following sections: Land, food and population; Physical factors; Man's use of the land; Marketing and prices; Population; and Standard of living. Throughout the text are 57 figures, 206 tables, 21 maps and 62 photographs. A detailed index is provided. The second volume (Atlas, with 179 maps and 20 figures and photographs) and the third (statistical data arranged in something over 300 tables), both in Chinese and English, are arranged so that they may be used independently or in conjunction with the first volume. Neither is indexed but the tables of contents are sufficient in both cases for satisfactory reference work.

AFRICAN NOTEBOOK.

By Albert Schweitzer. Translated by Mrs. C. E. B. Russell. Henry Holt and Co., New York. $2.00. 7⅓ x 5⅛; [6] + 144 + 9 plates; 1939.

In the year 1925, the author began to clear the forest and bush on the southern side of the broad-topped hill of Adolinanongo, on the banks of the River Ogowe above Lambarene in French Equatorial Africa, for the site of his new hospital: this was ready for occupation in January, 1927. It was at Adolinanongo that, in the seventies and eighties of the last century, there lived a young agent of the English trading firm, Hatton and Cookson, who later wrote his famous reminiscences of Africa under the pseudonym, Alfred Aloyius Horn—Trader Horn.

Dr. Schweitzer, world-famous as a medical missionary and musician, writes in his first chapter the fascinating history of the adventurous career of Trader Horn. Then the author proceeds to relate other tales of olden days, the part the present hospital plays in the lives of the natives, the many taboos and magic which affect the lives of the natives, and many anecdotes concerning the native nurses, patients, and visitors in the hospital. The author's most beautifully drawn character portrayal is that of *Oyembo* (the song), an African forest school-master who persuaded his villagers to rebuild their rotting huts, to clear their forest land in order to cultivate plantations of plantains, cassava, coffee, and cocoa for village and commercial consumption, to sell many rafts of logs to timber merchants, to organize village work and to set up bookkeeping for accurate payment of services to the villagers, and, most important of all, to establish a school for both adult and child education. All this was accomplished by a native teacher and his villagers without government aid—an unusual thing in Africa where the natives permit the heavy, rank growth of forest vegetation to surround their very huts

and clear only enough plantation ground for bare subsistence.

MIGRATION AND ENVIRONMENT. *A Study of the Physical Characteristics of the Japanese Immigrants to Hawaii and the Effects of Environment on Their Descendants.*

By H. L. Shapiro. With the Field Assistance of Frederick S. Hulse. Oxford University Press, London, New York and Toronto. $7.50. 9¼ x 6½; xi + 594; 1939.

Since Boas's startling observations on the head shape of the descendants of immigrants, the question uppermost in the mind of students of the subject is what significance to attribute to the findings so much at variance with certain accepted anthropological dicta. A first real attack on the problem has been made by Shapiro who in this book summarizes the results of a well conceived investigation dealing with Japanese immigrants in Hawaii. He has had measurements taken on samples of (a) Japanese immigrants in Hawaii; (b) their relatives who have remained in Japan; and (c) their offspring born and bred in Hawaii. Analysis of the data shows first of all that the Japanese who have migrated differ in trunk, head and face measurements from their sedentary relatives in Japan and from their own offspring as well. After taking into account such factors as occupation, sex, age and place of birth the author is led to conclude that this sample of immigrants represents a distinct sub-group of the population from which it derives. It could be inferred then that in migratory movements there is also physical selection. The differences between the Japanese parents and their offspring born in Hawaii are regarded by the author as effects of the environment, particularly better economic conditions. The importance of this investigation both from the standpoint of results and of methodology cannot be emphasized too strongly. It initiates an anthropology of migration and should stimulate further studies in a field where knowledge is painfully inadequate. The author's exposition is lucid and the statistical data are given in sufficient detail, the tabulations occupying almost two-thirds of the book.

THE MAROONS OF JAMAICA. *Anthropological Series of the Boston College Graduate School, Vol. 3, No. 4, Serial No. 12.*

By Joseph J. Williams, S. J. Boston College Press, Chestnut Hill, Mass. Subscription, $3.00; Single copy, $1.00. 9⅝ x 6½; 102; 1937 (paper).

The history of the Jamaica Maroons from the time of the arrival of Cromwell's soldiers in 1655 to the British Treaty of Peace with the Maroons in 1739 is outlined in detail in this monograph. Although it is believed by some that the Maroons of Jamaica are derived from the Arawak Indians, natives of Jamaica when the Spanish took over full occupation of the island in the early 16th Century, the author states that, contrary to this belief, the Maroons were primarily the African slaves of the Spanish who led these slaves to the mountains and established them there ". . .as a menace against Cromwell's soldiers after the latter had conquered Jamaica in 1655." Thereafter, the English imported their own slaves. Among these were the warlike, rebellious Ashanti, who chafed at English bondage and escaped to the mountain fastnesses of the Maroons. There the powerful Ashanti gained complete control and introduced their language and the divine worship of Nyankopon into the Maroon culture. In the early part of the 18th Century, about 1730, the appelation Maroon was extended to include the Ashanti as well as the original Spanish slaves.

The author has drawn heavily on the *Journals of the Assembly of Jamaica, 1709–1731*, and the *Acts of Assembly Passed in the Island of Jamaica, from 1681 to 1737 inclusive*, for the source material of this interesting study of the early conflicts between the British settlers and the Maroons.

An additional article by I. E. Thompson on the *Maroons of Moore Town* throws interesting light on the nature and customs of the present day Maroons.

TRIAL OF FIELD AND GRAY.

Edited by Winifred Duke. William Hodge and Co., London and Edinburgh. 10s. 6d. 8½ x 5½; vi + 302 + 9 plates + 1 folding chart; 1939.

This latest addition to the *Notable British Trials Series* (Vol. 67) is not quite up to the best, or perhaps even the usual, standards of that series. This is not because of any lack of thoroughness and competence on the part of Winifred Duke, the editor of the volume, but essentially because the case itself was a dull and stupid one. The completely idiotic behavior of Field and Gray, which would be incredible if it had not actually happened, brought about their prompt conviction almost automatically. Probably police and prosecution have rarely had an easier task in all the annals of crime than they had in this case. Two men, well known in a seaside resort, pick up a strikingly good looking girl from London taking her annual holiday; parade her along the main street in early afternoon of a summer day, meeting numbers of their friends and acquaintances along the way; and then proceed to beat her to death in mid-afternoon at a spot on the beach only a quarter of a mile away from a group of men with whom they had talked a few minutes before in passing, and practically in full view of a row of cottages less than a half mile away and on higher ground overlooking the beach. They then buried the body where it fell on the beach, and did this so inadequately that one foot was sticking out and tripped a small boy playing there next day. After this performance the two murderers sauntered home, and continued their normal habits of life in the town.

Enough has been said to indicate that this case really belongs to Ripley's *Believe it or Not* rather than to *Notable British Trials*.

THE SOUTHERN BANTU.

By L. Marquard and T. G. Standing. Oxford University Press, London, New York and Toronto. $2.50. 7⅞ x 4¾; vii + 262 + 2 folding maps; 1939.

A worthy addition to the rapidly growing literature on race relations between the ever-encroaching whites and the native peoples of Africa, this book explains the economic, political, social, educational, and religious life of the Bantu prior to and succeeding the European scramble for territory in South Africa. The greater part of this book deals with a study of the devastating effects of European invasion of Bantu territory in the Union of South Africa. The detribalizing and demoralizing effects on the Bantu at work in the mines and towns of the Union are discussed. In addition to a study of conditions in the Union, Bantu life in Southern Rhodesia, in the three Protectorates—Basutoland, Bechuanaland, and Swaziland, and South West Africa is presented in lesser detail.

A very clear picture is given of the chaos caused in the old tribal customs of the Bantu by European encroachment on and acquisition of land on which the Bantu had formerly lived in tribal groups as cattle owners and tillers of the soil. The economic problem, therefore, as well as antagonizing social and legal inequalities, prompts the Bantu to dislike the European as thoroughly as the European dislikes and misunderstands the Bantu. The authors believe that a thorough understanding of the early life of the Bantu prior to the European entrance on the scene will bring about a more sympathetic attitude on the part of the European to the present difficulties of the adjustments made necessary in the lives of the Bantu natives of South Africa. This is an excellent book for the promotion of better race relations.

LES TYPES HUMAINS. *Première Partie. Les Types Somatiques. Raciaux—Morphologiques—Constitutionnels. Deuxième Partie. Les Types Psychologiques. Tempéraments—Caractères—Types d'orientation générale de l'esprit—Types psychanalytiques—Types réflexologiques — Types psychosociologiques. Troisième Partie. Les Types Somatopsychiques. Variétés neurovégétatives. Constitutions somatopsychiques. Biotypes et variétés endocrinologiques. Types criminels. Actualités Scientifiques et Industrielles, 495, 496,*

497. Biologie du Travail et Biotypologie, III, IV, V.

By Eugène Schrieder. Hermann et Cie, Paris. Parts I and III, 20 francs each; Part II, 18 francs. 10 x 6¼; Part I, 104; Part II, 79; Part III, 105; 1937 (paper).

The purpose of these three publications is to review the principal methods of classification of body types and the results of investigations on the relationship between somatic structure and psychic behavior. The first volume surveys rapidly the morphologic types as defined by various workers from Manouvrier to Tschernorutzky. In greater detail are presented the views of the French and Italian schools of constitutionalists. The author concludes that the rather complicated index of Viola is the most adequate to describe metrically the characteristics of the physique. In the second volume Schrieder examines the classifications of psychological types as viewed from the standpoint of psychoanalysis, clinical psychiatry, endocrinology and of the various schools of psychology. He finds that the several classifications have few elements in common and therefore they are not strictly comparable. In the third volume he brings together the threads of the preceding volumes and discusses the relationship between physique and psyche with emphasis on the studies of Kretschmer, Jaensch and of Pende. Included here is also a chapter on criminal types. The main conclusion reached is that more and careful work is necessary before a definitive idea can be had of the significance and degree of the somato-psychic correlations observed. The author has made painstaking efforts to be clear and thorough even if brief and as a result this is a valuable work for the student of the subject.

CAUSES OF CRIME. *Biological Theories in the United States 1800–1915.*

By Arthur E. Fink. University of Pennsylvania Press, Philadelphia; Oxford University Press, London. $3.00. 9 x 6; xi + 309; 1938.

This historical survey of the anthropological, psychological and genetic theories on the causation of crime is purposely and mainly dedicated to the American students of these aspects of criminology. The author covers the period from 1800 to 1915 beginning with Rush, to whom is given credit for emphasizing the relation of crime to psychopathology, down to Healy, the foremost exponent of the study of the personality of criminals. In between these periods criminological thought has been concerned with phrenology, the concepts of Lombroso on the criminal man, eugenics, and the relation of crime to mental deficiency. From the impact of these ideas have resulted numberless viewpoints which vary from a complete denial of the existence of an environmental factor in the causation of crime to the acceptance of the influence of both nature and nurture. It is obvious from this survey that the majority of theories that have been advanced have very little if any factual foundation and as a matter of fact also lack originality, so that one cannot really speak of an American School of Criminology. In addition, none of the theories has been effectual in establishing criminology on a solid scientific basis. This failure may be largely due to the fact, which the author does not mention, that this country has had more than its share of sentimental penologists. These, incidentally, should also be enumerated among the causes of crime. The book is well written and very interesting. Its one real flaw derives from the author's attitude which is not sufficiently critical and from his desire to present the views in vogue here without too much reference to their foreign origin. This disembodiment has the consequence of distorting the picture of the theoretical developments considerably. There is an index and an ample bibliography.

THE MICROBE MAN. *A Life of Pasteur for Young People.*

By Eleanor Doorly. Introduction by Pasteur Vallery-Radot. Woodcuts by Robert Gibbings. D. Appleton-Century Co., New York and London. $1.50. 8 x 5⅜; xiii + 160; 1939.

In her delightful book *The Insect Man*, Miss Doorly displayed her rare talent for writing stories, concerning great men of

science, which are both scientifically and biographically correct, and at the same time interesting and readable to the children for whom they are intended. The present volume is well up to the high standard set in the earlier work, and the author is to be congratulated for her fine achievement.

The story of Pasteur's life is unfolded as the author visits the places where he lived and worked, and talks with the people who knew and loved him. The delightful style and the interesting subject matter of the book are well illustrated in the following excerpt (pp. 159–160):

"No one who died was ever so alive among us as Louis Pasteur. You meet pasteurized milk on any doorstep, and, if you have any imagination, you see his delightful face looking out at you from the mighty pasteurizing plant of all the dairies of the world, watching over your safety. Every dog you meet wags his tail and smiles at the thought that no one need fear a mad dog any more, because such things have ceased to be. In the sunny mountains, any old silkworm breeder will say to you: 'Pasteur saw to it that we never lose our worms.' In every chicken run, the hens; in every field, the lazy cows and sheep and pigs say the old bad days are over.

The woodcuts by Mr. Gibbings make a worthy contribution to the excellence of this pleasant volume.

THE NATIVE RACES OF AFRICA AND MADAGASCAR. *Anthologia Anthropologica. A Copious Selection for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer.*

By Sir James G. Frazer. Arranged and Edited by Robert A. Downie. Percy Lund, Humphries and Co., London. 35s. net. 11 x 8½; xii + 578; 1938.

Sir James Frazer early began the practice of extracting from his readings all those passages which in any way pertained to the social or religious life of primitive peoples. The book, of which the present volume

is the first instalment is in essence an epitome or rather an anthology of Social Anthropology. When I first addressed myself to that study more than fifty years ago I made a practice of noting in a book the passages of authors which seemed to me of particular significance in their descriptions of the manners and customs, the beliefs and practices, of the various races of men, especially of those races of backward culture, an understanding of whom is of special importance for a knowledge of our race. In course of time these notebooks multiplied, and it is their contents which I now wish to lay before the reader.

The volume before us, dealing only with the native races of Africa and Madagascar (something over 200 separate peoples) contains a wealth of material mostly extracted (quoted verbally) from English books but not infrequently from French and German works. Very little of this material has appeared in Sir James Frazer's published writings. It begins with the primitive Bushmen and Hottentots of South Africa and proceeds northward to the ancient Egyptians and then to the island of Madagascar. The reader "will hear little or nothing about the higher cultures of Dutch, English, Portuguese, Belgian, French, and Italian origin, which from time to time have been superimposed on the indigenous population by European immigrants in many parts of the continent." Outline maps indicate the territories of the chief races and the index adequately covers the 550 pages of text.

ECONOMICAL ADMINISTRATION OF HEALTH INSURANCE BENEFITS. *Studies and Reports. Series M (Social Insurance) No. 15.*

International Labour Office, 734 Jackson Place, Washington, D. C.; P. S. King and Son, London. $1.75. 9½ x 6⅜; vii + 332; 1939.

ECONOMICAL ADMINISTRATION OF HEALTH INSURANCE BENEFITS. *Part I. The Principle of Economy in the Administration of Health Benefits. (Extract from the volume published under that title in "Studies and Reports," Series M, Social Insurance, No. 15.)*

By Walter Pryll. International Labour Office, Geneva. $1.75. 9¼ x 6⅜; iv + 137; 1938 (paper).

The purpose of this report is to draw attention to the medical task of compulsory social insurance institutions and to study in particular the problem of applying the principle of economy to the medical and pharmaceutical benefits of sickness insurance funds. Part I of the volume analyzes in a very broad way the duties of the social

insurance practitioner and deals with the principle of economy in diagnostic, therapeutic and prophylactic activities. This part written by Walter Pryll, a former medical adviser of the Berlin Local General Sick Fund, is also published separately (see the second of these publications listed). Part II of the volume is a useful collection of information containing an analysis of the laws, regulations and principles of social insurance measures in force in seven countries, namely Czechoslovakia, France, Germany, Great Britain, Hungary, Poland, and Yugoslavia. Part III gives an account of the conclusions adopted on the subject of economical treatment and prescribed by some international bodies such as the International Labor Office, the International Medical Association, the International Conference on Social Insurance and Mutual Aid.

THE CZECH CONSPIRACY. *A Phase in the World-War Plot.* Second (Enlarged) Edition.

By George Lane-Fox Pitt-Rivers. Boswell Publishing Co., London. 3s. net. 8¾ x 5½; 93 + 8 plates; 1938.

The author, an eminent British ethnologist, outlines briefly the 20 year old history of the Czech Republic from the time of Masaryk and the famous self-determination policy to the signing of the equally famous Munich Pact; states his view of the causes of the 1938 Czech Crisis; justifies the Munich Pact; and, in general, presents the side of the Czech story that the newspapers and periodicals of England and the United States ignore, namely that of alleged Czech terrorism in German Sudetenland. Captain Pitt-Rivers discusses the low social status, great unemployment, poor housing and sanitary conditions, and general mass depression of the 3½ million Sudeten Germans under Czech Rule. Included in this study are population statistics on the diverse racial groups in Czechoslovakia. These figures indicate that the policy of self-determination was accepted after the World War as a happy solution to the weighty problem of the most effective way in which to weaken Germany in Central Europe and to break up the Austro-Hungarian Empire. The author believes that the Munich Pact does nothing more than rectify the injustices brought about by the so-called self-determination of the Peace Treaty and "that real friendship and co-operation between Great Britain and Germany are essential to the establishment of enduring peace not only in Western Europe but throughout the world. . . ."

This book, however, went to press November 15, 1938, four months before the coup of March, 1939, involving the non-German peoples of Czechoslovakia.

SOCIAL ECOLOGY. *A Critical Analysis.*

By Milla A. Alihan. Columbia University Press, New York. $2.75. 8½ x 5½; xiii + 267; 1938.

The ecological school of thought in sociology results from the efforts of R. E. Park and E. W. Burgess, who, borrowing biological terminology, have set as their objective to study the 'relationships of symbiosis, or the factors involved in living together, independent of communication' (p. 11) or, as stated elsewhere, 'the spatial and temporal relations of human beings as affected by the selective, distributive, and accommodative forces of the environment' (p. 9). In the pursuit of these objectives a group of social scientists centering around the University of Chicago are actively engaged today and in truth have contributed much factual information to various sociological questions. The author, who is obviously not of the group, has undertaken to examine critically the theoretical principles underlying the ecologist's standpoint, particularly his concept of person, social organism, community and society. In addition the author examines a few of the theories of the authorities on which Park and his school lean heavily. The result of this critical study is to show rather clearly that, to put it mildly, there exists some confusion as to what the ecologists are really driving at and what is the actual meaning of the terms bandied

about so readily. Alihan's arguments are rather sound and persuasive. The author manifests admirable self-restraint in avoiding the irony and sarcasm one would be tempted to adopt in this case and really demonstrates an unusual insight into the logical requirements of the subject.

KARL PEARSON. *An Appreciation of Some Aspects of His Life and Work.*

By E. S. Pearson. The University Press, Cambridge; The Macmillan Co., New York. $3.75. 10⅝ x 7½; viii + 170 + 9 plates; 1938.

It is difficult for a son to write a biography of his father. This is partly because he is too close to his subject to view it in perspective, but chiefly because a son remembers so many intimate details that a sense of delicacy precludes sharing with the public, even if, indeed, the public wishes to share them. In this instance the son has shown remarkable taste in his selection of material. He has not attempted an exhaustive biography; rather he has pictured a personality, a smaller but frequently a more difficult task.

Karl Pearson was a many sided genius. This is evidenced by the advertisement on the cover of this book in which are listed works from his pen dealing with such divers subjects as death rate, the life of Galton, and the portraiture of Jesus Christ and Oliver Cromwell. And it must be remembered that the same mind that computed the *Tables for Biometricians and Statisticians* also produced a Passion Play. Such minds were not uncommon in the days of Leonardo da Vinci, Michelangelo, and Zarlino, but the post-renaissance period has been one of specialization, and intellects of this type are now few and far between. But Pearson was also a human being—a fact not always appreciated by those who know him only by his formulae. It is the human Pearson that his son introduces in this book, and who speaks again from its pages, this time to a wider audience of those who were not privileged to know him in the flesh.

EDMUND BURKE AND HIS KINSMEN. *A Study of the Statesman's Financial Integrity and Private Relationships. University of Colorado Studies. Series B. Studies in the Humanities. Vol. 1, No. 1.*

By Dixon Wecter. University of Colorado, Boulder. $1.00. 10 x 7; 113; 1939 (paper).

Edmund Burke has been the subject of not a few biographies, interest in him being stimulated not only by his unique personality but also by the mysteries which surround his life, particularly in relation to religion and finances. It is on the latter topic that the author has focussed his attention. Aided by documentary relics he seeks to piece together the available information about the financial troubles directly involving certain of Burke's kinsmen and indirectly Burke himself through his relationship and his strenuous defense of their obvious misdeeds. When the facts are ordered, Burke's participation in the frauds committed by his brother and alleged cousin is not certain beyond a reasonable doubt. However, he could not have been ignorant of their acts and so, legally speaking, was really an accomplice. All things considered, the author suggests that Burke's overt attitude might have been the consequence of strong familial attachment and the everlasting ambition to rise as far as possible above his humble origin. This charitable viewpoint seems to receive adequate support from the data at hand and the author is to be complimented on the order which he gives to the accumulated facts and on the scholarliness he demonstrates. This touches on the pedantic sometimes, especially through the continuous use of footnotes. Had they been avoided the monograph, interesting as it is, would have made for enjoyable reading.

SOUTH WEST AFRICA IN EARLY TIMES. *Being the Story of South West Africa up to the Date of Maharero's Death in 1890.*

By Heinrich Vedder. Translated and Edited by Cyril G. Hall. Oxford University Press, New York and London.

$6.00. 8⅝ x 5½; xv + 525 + 9 plates + 2 folding maps; 1938.

A detailed history of South West Africa up to 1890 which has been compiled from a vast number of individual records of both natives and Europeans—old reports, letters, and diaries collected in the twenty-eight volumes of the *Sources of the History of South West Africa*. From these records and from German literature on the subject, the author has drawn a comprehensive picture of South West Africa from the time of early explorations up to 1890, when the history of early South West Africa ends. The author is preparing a subsequent volume on German South West Africa.

Of particular interest in this historical and ethnological study is the vivid picture of the political, economic, social, educational, and religious life of the many African races in the country. The author tells also of the many feudal wars between the Namas, Afrikaners, Hereros, Orlams, and other tribes for power and grazing land in a country which is largely barren. To the South West Africans cattle meant wealth but cattle also meant fair grasslands. Therefore, the history of this part of Africa is of a constant tug of war between tribes for grazing land.

MORPHOLOGIE SOCIALE.

By Maurice Halbwachs. Librairie Armand Colin, Paris. 17 francs 50 (cloth); 15 francs (paper). 6¾ x 4½; 208; 1938.

This is an exposition of certain aspects of human social behavior along the directives laid down by Durkheim for whom the facts generally studied in demography express the morphology of the social structure, the concrete results of social interrelations. In the first section of the booklet the author illustrates this viewpoint by considering religion, politics and economics. He utilizes, as an example, some unique data on church attendance in France to discuss the declining trend in the religious behavior of the French population in terms analogous to those adopted in the study of population—births, deaths, density, etc. A similar procedure is followed in the examples regarding political behavior and industrial and commercial conditions. In the second section of the book the author examines the strictly vital statistics, the state and movement of the population of France and other countries, but always with emphasis on their significance as end results of social interactions. The author reaches no new conclusion but the sober discussion and clear exposition of the subject given here will be useful to an understanding of the sociological approach to demography.

THE NOBEL PRIZES AND THEIR FOUNDER ALFRED NOBEL.

By Fritz Henriksson. Alb. Bonniers Boktryckeri, Stockholm. 8½ x 5¾; 59; 1938 (paper).

In this little paper Henriksson has given a brief account of the genealogy of the Nobel family, and as complete a biography as is available of Alfred Nobel, founder of the Nobel prizes. The great chemist left, at his death, a fortune which amounted to nearly 9 million dollars. In his will, he made provisions for the awarding of the five annual prizes; one in chemistry, one in physics, one in physiology or medicine, one in literature, and one in the field of international fraternity, or world peace. The democratic spirit of the will is shown in Nobel's declaration "... that, in the awarding of prizes, no consideration whatever be paid to the nationality of the candidates, that is to say, that the most deserving be awarded the prize, whether of Scandinavian origin or not."

The paper contains also a list of Nobel prize winners since 1901. Several photographs depicting the pomp and ceremony attached to the awarding of the prizes are included.

UNSOLVED MYSTERIES OF THE ARCTIC.

By Vilhjalmur Stefansson. Introduction by Stephen Leacock. The Macmillan Co., New York. $3.50. 8⅜ x 5⅝; xi + [7] + 381; 1939.

This entertaining volume discusses five Arctic "mysteries"—the disappearance of the colony of Europeans set up in Greenland around 985 A.D.; how Sir John Franklin's expedition including more than a hundred persons managed to die to the last man in the midst of relative plenty; the strange fate of Thomas Simpson; how Andrée died; and the case of the missing Soviet fliers.

As is to be expected from its distinguished author, the book is written with great clarity and charm. The tentative solutions of the mysteries are logical, and persuasive because of their logic. It is difficult to avoid the conclusion that Stefansson has the right answers. The documentation is extensive and critical. In fact the whole production may be said to adorn the rigors of sound historical scholarship with the charm of good literature.

VIKINGS OF THE SUNRISE.

By Peter H. Buck. Frederick A. Stokes Co., New York. $3.50. 8½ x 5¾; xiii + 335 + 31 plates; 1938.

"Polynesian Romance" or "The Heritage of the Polynesians" may well have been used as the title of this fascinating story. The author, himself half Polynesian, has traced the ancestry of the people of the Pacific Isles from the earliest great seafaring race from the Asiatic mainland down to the present Polynesian, Melanesian and Micronesian groups. He has made use of ancient folk lore as well as the present geographic distribution of anthropologic and linguistic types in presenting this interesting discourse. Buck's thorough personal acquaintance with the island groups, and his ability to hold their confidence and good will in the collecting of anthropometric data on some 2500 living people from representative parts of Polynesia, have well qualified him for such an undertaking.

The text is interestingly written and is well supplied with illustrations of representative peoples, landscapes, and artifacts of the island groups. The volume contains a bibliography and an index.

CRIME AND PUNISHMENT IN EARLY MARYLAND.

By Raphael Semmes. The Johns Hopkins Press, Baltimore. $3.00. 9 x 6; [8] + 334; 1938.

A most interesting history of the lives of the seventeenth century Maryland colonists by the author of *Captains and Mariners of Early Maryland*. In this volume Semmes treats in a scholarly fashion, and with considerable humor, the numerous crimes and so-called crimes of this period which together give a rather complete picture of the domestic lives of the people. Ten chapters discuss every conceivable offence from mere hog stealing and profanity to assault, homicide, and adultery. Other chapters discuss housing and clothing, and servants and their discipline and punishment. A final chapter deals at length with the treatment given the sick during the seventeenth century and also mentions some of the customs observed at burials.

All statements made in the text are supported by citations at the back of the book most of which refer to volumes of the Archives of Maryland. Frequent quotations from old court records give added interest to the author's most readable volume. There is both an index of topics and of persons.

THE STANDARD OF LIVING IN BRISTOL. *A Preliminary Report of the Work of the University of Bristol Social Survey.*

By Herbert Tout. J. W. Arrowsmith, Bristol. 1s. net. 8½ x 5⅜; 64; 1938 (paper).

A preliminary report of certain aspects of a more comprehensive social survey of Bristol which is nearing completion. "This report is concerned only with incomes which fall below middle-class levels, and consequently it covers four-fifths of all Bristol families. Its purpose is to study the standard of living in Bristol. How many families just exist and how many live?" Of the total group it is estimated that 12,000 families are very comfortable; 56,000 families are just ordinary; 21,000 families "not in poverty but whose lot is far from comfortable"; and 11,000 families in poverty.

The tabular matter is presented in the text and in the three appendices.

DR. IDA: INDIA. *The Life Story of Ida S. Scudder.*

By Mary P. Jeffery. Fleming H. Revell Co., New York, London and Edinburgh. $2.00. 8 x 5¼; 212 + 10 plates; 1938.

This is the life story of Ida S. Scudder, president of the Medical College for Women, Vellore, India, a medical missionary in India since the turn of the century. The material for the book was collected by Dr. Mary Pauline Jeffery, one of Dr. Scudder's colleagues, and was prepared for publication by Lucy W. Peabody of Beverly, Massachusetts. Dr. Scudder's chief work naturally was with the women of India and we are given many glimpses of the customs and superstitions with which she had to cope in her treatment of her patients. In addition there are stories and anecdotes of many other phases of Indian life. A chapter on caste, one on untouchables and on roadside dust give the book added interest.

VERNON KELLOGG 1867–1937.

Belgian American Educational Foundation. Anderson House, Washington, D. C. 9¼ x 6⅜; xi + 160; 1939.

This beautiful volume is a worthy tribute to the memory of a distinguished biologist, who played a broader role on the world stage of his time than most scientific men ever do. His life's work influenced the course of human affairs in ways that were good and effective far beyond the conventional boundaries of science. A clear-headedness that was Gallic in its simplicity and directness combined with a boundless buoyancy of spirit and genius for friendship to make Vernon Kellogg's life truly a benefaction to his fellow men.

RASSENKUNDE UND RASSENGESCHICHTE DER MENSCHHEIT. *Erster Band. Die Forschung am Menschen. Sechste Lieferung (Bogen 40–47). Zweite umgearbeitete und erweiterte Auflage.*

By Egon Frhr. von Eickstedt. Ferdinand Enke Verlag, Stuttgart. RM. 9.20. 10½ x 7; 625–752; 1938 (paper).

Previous issues of this second edition (with the exception of *Lieferung* 5 which has not yet been published) have been noticed in these columns (Numbers 1 to 3 in Vol. 13; No. 3, and Number 4 in Vol. 14, No. 1). This number treats the structure and developmental processes of body form and its abnormalities.

A GRAPHIC SUMMARY OF AGRICULTURAL CREDIT. *U. S. Department of Agriculture. Miscellaneous Publication No. 268.*

By Norman J. Wall and E. J. Engquist, Jr. Government Printing Office, Washington. 10 cents. 9¼ x 5¾; ii + 48; 1938 (paper).

This is one of a series of ten graphic summaries dealing with American agriculture. Maps and diagrams clearly depict the distribution of farm mortgages, loans, and banking activities. The time period covered is in large part up to and including the year 1937.

ZOÖLOGY

DIE BIOLOGIE DER EUROPÄISCHEN IGEL. *Monographien der Wildsäugetiere, Band V.*

By Konrad Herter. Verlag Dr. Paul Schöps, Leipzig. RM. 10.80 (paper); RM. 12 (cloth). 9½ x 6¾; [6] + 222; 1938.

This monograph on the European hedgehog is so full of interesting material that one hardly knows where to begin to review it. Its anatomy, geographic range, natural history, and behavior, and the systematics of the genus are all recorded from a careful review of the literature and the personal observations of the author. Included in the natural history section are the animal's ecological habitats, its breeding activities, growth, enemies, diseases, etc.

This little animal has always attracted the attention of the layman and records of it abound in folklore and poetry. We are sorry to learn that some of its quaint habits are severely discredited by the

author, especially the one concerning the habit of carrying fruit on its quills. That the hedgehog is a depredator of chicken eggs is shown to be a fallacy although it will eat small birds' eggs, but not by natural instinct. Its fame as a mouse hunter is likewise not accepted with much favor by the writer.

A bibliography and several plates of photographs and charts help to make this volume an important contribution to the biology of one of Europe's most characteristic mammals.

MARVELS OF THE INSECT WORLD.

By Jean-Henri Fabre. Edited, Annotated, and Translated by Percy F. Bicknell. Illustrated by Robert Gibbings. D. Appleton-Century Co., New York and London. $2.50. 8 x 5¼; xii + 239; 1938.

This is an excellent translation of one of the numerous scholarly works of the world famed naturalist, Jean-Henri Fabre. The work begins with an elementary consideration of insects in general, and then proceeds through many of the well-known orders, giving detailed discussions about the natural history, habits of reproduction, instincts, and economic value of the different forms. The detail and accuracy of Fabre's stories about insects indicate that he was a naturalist of the first order, and that he justly deserves the titles "an inimitable observer" and "the insect's Homer" given him by Darwin and Maeterlinck, respectively.

The wood-cuts by Mr. Gibbings are quite up to the standard set in Doorly's *The Insect Man* and *The Microbe Man*.

THE WATCHER AT THE NEST.

By Margaret Morse Nice. The Macmillan Co., New York. $2.00. 8½ x 5¾; [12] + 159; 1939.

Even more interesting than her *Life History of the Song Sparrow* is Mrs. Nice's *The Watcher at the Nest*. The enthusiastic interest in her feathered pals, and her ability to make a presentation which actually reveals personality in birds, has made this book an extremely valuable contribution to the field of ornithology.

A large portion of the volume is devoted to a discussion of the activities of several individual birds; their migrations, matings, broods, songs, and personal characteristics. The study required some eight years of patient and painstaking observation and many hours of desk work in interpreting those observations.

The latter portion of the book is devoted to discussions on the activities of cowbirds, warblers, vireos, mourning doves, herons, quails, and numerous other birds that came under the author's observation while she was making detailed studies on the song sparrow. Whenever the opportunity presents itself, Mrs. Nice makes an earnest plea for the preservation of weeds and brambles and all the other forms of shelter and sources of food that are rapidly being cleared away to satisfy man's selfish interest in becoming more and more civilized.

THE UNDERWATER ZOO.

By Theodore McClintock. The Vanguard Press, New York. $1.75. 8 x 6; ix + 111; 1938.

This book is developed around the building and maintaining of a home-made fresh water aquarium. McClintock writes in a delightful style, and the exciting drama of his underwater zoo should stimulate countless boys and girls to develop a similar project within their homes. The text is entirely void of any scientific terms and discussions, and at the same time it presents a lot of keen scientific observations.

Some of the illustrations might be criticized by scientific artists, but they fully answer their purpose in adding charm to this pleasant little volume. The last chapter presents plans for building an underwater zoo, and gives an excellent list of texts to be used in identifying, classifying, and studying the natural history of the forms most likely to be encountered in the development of such an enterprise.

TROUT STREAMS. *Conditions that Determine Their Productivity and Suggestions for Stream and Lake Management.*

By Paul R. Needham. Comstock Pub-

lishing Co., Ithaca. $3.00. 9 x 6; x + 233; 1938.

The conservation of our North American trout through the development and care of the fresh-water streams suitable for their existence has engaged the attention and whole hearted activity of many private, as well as many government institutions for the past two decades. There has been a real need, not only for trout conservationists and sportsmen but for the general lay population as well, of a comprehensive treatment of the natural history and the economy of the trout of our North American streams. Needham's long field experience well qualifies him for the task of fulfilling this need.

Such topics as stream conditions, composition and distribution of the trout's food supply, and lake and stream management are thoroughly and interestingly discussed. Several sections dealing with the taxonomy of trout, and instructions for field surveys have been appended to the original text. A bibliography of some 140 titles and an index conclude the volume.

ZOOLOGICA. *Scientific Contributions of the New York Zoological Society. Volume XXIII, Part 4, Numbers 17–21.*

New York Zoological Society, Zoological Park, New York. $1.15. 10½ x 7; vii + 319–405; 1938 (paper).

The following papers are listed in Part 4 (nos. 17–21) of this publication: (1) The phylogeny of the characin fishes, William K. Gregory and G. Miles Conrad. This paper is well illustrated with 37 line drawings, gives a pictorial classification of the characins, and a bibliography of 52 titles; (2) Eastern Pacific Expeditions of the New York Zoological Society. XVI. Holothurians from the western coasts of Lower California and Central America, and from the Galápagos Islands, Elisabeth Deichmann (15 text-figures; bibliography, 53 titles); (3) A note on eggs and young of *Leiobeterodon madagascariensis* (Duméril and Bibron), Roger Conant (1 plate); (4) An unusual aberrantly colored Pleuronectid, C. M. Breder, Jr. (1 plate); (5) A diagnostic test for the recognition of tuberculosis in Primates; a preliminary report, Charles R. Schroeder (2 plates); (6) Index to Volume 23.

A CATALOGUE OF VERTEBRATES OF JAPAN. *By Yaichiro Okada. Maruzen Company, Tokyo.* $3.00 in U.S.A.; 12s. in Europe. 9½ x 6½; iv + 412; 1938.

The writer has compiled a catalogue of 3823 vertebrates to be found in Japan and neighboring islands. This list has been derived from previously published faunal lists and apparently the writer has not undertaken to vouch for their accuracy but accepts them without comment. The value of the book would have been greatly increased had references to the original descriptions of the various forms been included. It is also unfortunate that the classification of the Aves is based on a rather unique system and does not follow the now generally accepted arrangement of Wetmore.

However, the list does give an indication of the vertebrate fauna of Japan and should be of value to the zoogeographer as well as the taxonomist. There is an index to generic and specific names.

DIE SEIDENSPINNER. *Ihre Zoologie, Biologie und Zucht. Technologie der Textilfasern, Band VI, Teil 1.*

By Fr. Bock and L. Pigorini. Verlag von Julius Springer, Berlin. RM. 16.80. 9¾ x 6¾; vii + 171; 1938.

This is an excellent brief description (with 144 illustrations) of the morphology, histology, development, physiology and diseases of the silk-worm. Most of the discussion concerns the common *Bombyx mori* L. although other silk producing organisms, such as *Bombyx fortunatus, B. arracanensis* and *Antheraea yamamai* are not ignored. The book begins with a brief review of the history and present status of the silk industry in Europe, Asia, and the United States. L. Pigorini contributes a chapter (translated into German by the senior author, who has also written the rest of the book) on the culture of the silk-worm. The author expresses the hope that this book will help to stimulate a new interest, in

Germany and other European countries, in the production of real silk.

SPECKLED NOMADS. *A Tale of Trout in Two Rivers.*

By H. E. Towner Coston. The Macmillan Co., New York. $3.00. 7¾ x 5¼; 299 + 32 plates; 1939.

The lowlands of England and the rugged expanses of New Zealand are settings for the biographies of two trout. The author is a keen observer of nature and writes his story in a charming style. However, he does not sacrifice biological fact to wild speculation, despite the gaps in our scientific knowledge of fish behavior. Vivid descriptions of encounters between man and fish reveal the thrill that Mr. Coston feels in the screaming reel and the bent rod. Yet never is the value of conservation overlooked. Methods are shown whereby the fish are protected not only from unscrupulous anglers, but also from the depredation of birds and aquatic denizens who prey on egg, alevin, or small fry. This volume, like *Beneath the Surface* (cf. Q.R.B., 1938) contains many interesting and attractive illustrations.

DIE TIERISCHEN PARASITEN DES MENSCHEN.

By Walter Stempell. Verlag von Gustav Fischer. RM. 12. (paper); RM. 13.50 (cloth). 10¼ x 6¾; viii + 226; 1938.

The systematic order of this monograph on animal parasites of man, written by an experienced zoologist, is very useful. It will contribute especially to the knowledge of medical students and physicians concerning parasites, and is illustrated with a great many fine and distinct drawings, made mostly by the author himself. All the descriptions given of the single species are short and concise, emphasizing in particular their meaning as parasites of man. There is a complete subject index.

SHARP EARS, THE BABY WHALE.

By John Y. Beaty. Illustrated by Helene Carter. J. B. Lippincott Co., New York, Philadelphia and Toronto. $2.00. 8¼ x 8½; 107; 1938.

Delightfully told, in a clear and crisp style, the story of the adventures of a baby whale should prove of interest and amusement to children of all ages. Following the amazing adventures of our hero in his five-year trip around the world, one incidentally acquires quite a store of information concerning the strange marine world and its inhabitants in general, and whales in particular. In addition, a smattering of geography is thrown in. Among Helene Carter's delightful illustrations is included a pictorial map of the world showing Sharp Ears' course and the places in which his various adventures befell him.

THE BRITISH MOSQUITOES.

By J. F. Marshall. British Museum (Natural History), London. 20s. 10 x 7; xi + 341 + 20 plates; 1938.

This is an elaborate description of the 29 species of mosquitoes (Culicinae) that have so far been found in Britain. The eggs, larvae, and adults, as well as their life history and ecology are described in detail. Numerous figures and color plates, keys to adults and larvae, make this volume invaluable to medical and economic entomologists. Several chapters are devoted to malaria and malaria control in Britain, as well as to the biology of mosquitoes in general.

MOO-WEE, THE MUSK-OX.

By Jane Tompkins. Illustrated by Kurt Wiese. Frederick A. Stokes Co., New York. $1.50. 8¼ x 6⅛; xi + 103; 1938.

The author is familiar with the Arctic and has produced the kind of book for children (from six to eight years) that is not only entertaining but is also authentic in detail. Moo-Wee's life is made interesting and exciting by the many kinds of Arctic animals which the author introduces into her story, as well as the little Eskimo boy with whom the baby musk-ox lives for a while. The drawings, by Kurt Wiese, are delightful and the

large clear type makes the book easy to read.

A CONTRIBUTION TO THE BIOLOGY OF NORTH AMERICAN VESPINE WASPS. *Stanford University Publications, University Series. Biological Sciences, Volume VIII, Number 1.* *By Carl D. Duncan. Stanford University Press, Stanford University, Calif.; Oxford University Press, London.* $2.50 (paper); $3.25 (cloth). 10 x 7; 272; 1939.

One half of this work is devoted to the morphology and taxonomy of North American wasps belonging to the genera *Dolichovespula*, *Vespula*, and *Vespa*. The remainder is a critical review of the life history of these insects with the author contributing his own observations. 54 plates, an index, and a bibliography make this a handsome addition to the subject of entomology.

ANIMAL ECOLOGY. *Second Edition.* *By A. S. Pearse. McGraw-Hill Book Co., New York and London.* $5.50. 9 x 6; xii + 642; 1939.

The first edition of this treatise on animal ecology has been reviewed in these pages (Vol. 1, No. 4). The present text has been completely revised, seven new chapters added, and the bibliography greatly enlarged. A previous criticism of this book mentioned its lack of illustrations; the new edition now contains many photographs and drawings.

AMERICAN ANIMAL BOOK. *By Philip L. Martin. Alfred A. Knopf, New York.* $1.75. 9 x 6; [36]; 1938.

This picture book of animals consists of illustrations of 32 wild animals of America. The drawings themselves are simple and accurate and might easily appeal to a child, but the artist's economy in the use of color often gives a false impression as to the true coloring of the beasts depicted.

WHAT SHELL IS THAT? *A Guide to the Shell-Bearing Mollusks of Eastern North America.* *By Percy A. Morris. D. Appleton-Century Co., New York and London.* $2.25. 3¾ x 6; vii + 198; 1939.

An excellently prepared pocket manual which amateur collectors will find most useful. It describes in full and illustrates (photographs in black and white) the typical fresh and salt water shells to be found from Labrador to Cape Hatteras and inland to the Mississippi River.

A NEW PIKA (MAMMALIAN GENUS OCHOTONA) FROM SOUTHEASTERN IDAHO WITH NOTES ON NEAR-BY SUBSPECIES. *University of California Publications in Zoology, Vol. 42, No. 6.* *By E. Raymond Hall and H. Lorraine Bowlus. University of California Press, Berkeley.* 25 cents. 10¼ x 6¾; 6; 1938 (paper).

FURTHER STUDIES IN REGULATORY DEVELOPMENT OF TRITURUS TOROSUS. *University of California Studies in Zoology, Vol. 43, No. 9.* *By Richard M. Eakin. University of California Press, Berkeley.* 35 cents. 10¼ x 6¾; 26; 1939 (paper).

BOTANY

GENERAL PLANT PHYSIOLOGY. *By E. C. Barton Wright. Foreword by Sir F. Gowland Hopkins. P. Blakiston's Son and Co., Philadelphia.* $4.50. 8⅜ x 5½; 539; 1938.

PLANT PHYSIOLOGY. *With Reference to the Green Plant. Second Edition.* *By Edwin C. Miller. McGraw-Hill Book Co., New York and London.* $7.50. 9 x 6; xxxi + 1201; 1938.

The first text, written from a completely modern viewpoint for first and second year university students, is divided into the following parts: (1) General physiology of the cell (6 chapters), (2) Metabolism (7 chapters), and (3) Growth, reproduction and irritability (4 chapters). There are 44 diagrams in the text, an appendix

on the conception of pH, a general bibliography of 87 titles, and author and subject indexes. The author, formerly lecturer in Botany in the University of London, is now biochemist to the Research Association of British Flour Millers.

The second of these volumes, an excellent text for advanced workers on the physiology of the green plant, has been subjected to the necessary additions and eliminations in order to bring it up to date (first edition appeared in 1931; cf. this Review, Vol. 6, No. 4). The questions that concluded each chapter in the first edition have been omitted in order to conserve space. A commendable feature of the book, which materially adds to its usefulness as a reference book, is the lengthy bibliography which concludes each chapter.

BACTERIAL METABOLISM.

By Marjory Stephenson. Longmans, Green and Co., London, New York and Toronto. $7.50. 8½ x 5½; xiv + 391; 1939.

The rapid advance in our knowledge of bacterial biochemistry since 1930, when this book first appeared in the *Monographs on Biochemistry*, has made the exhaustive treatment of the whole subject by one author no longer possible. Now, in publishing the book separately as a text for advanced students, the material has been brought up to date. The new edition is as comprehensive as it can be, the articles cited extending from one published in 1838, through Pasteur's "Memoire sur la fermentation alcoolique" of 1860, to various papers published up to the time of writing. Summarizing tables are included in the text, and the appendix gives formulae for various media.

Not only does the author discuss the development of the main trends in bacterial biochemistry thus far, but she also indicates some of the more promising leads for future work.

FUNDAMENTAL PRINCIPLES ON BACTERIOLOGY *with Laboratory Exercises.*

By A. J. Salle. McGraw-Hill Book Co., New York and London. $4.00. 9 x 6; xiii + 679; 1939.

Stressing chemistry as the basis of modern bacteriology, Salle has presented a well-rounded account of pathogenic and non-pathogenic microörganisms. Planned as an introduction to the subject for students majoring in bacteriology, or as a survey for those whose only course it will be in the field, the book justifies the title. The basic concepts are adequately and clearly, though of necessity briefly, discussed. Although the book runs to nearly seven hundred pages, it is no longer than it needs to be. Indeed, in view of the present trends in bacteriology, the section on filterable viruses might well be longer. The bibliographies, too, might well include more references to the journals, both for the classical articles and for those of the "work-in-progress" type.

THE LEGUMINOUS PLANTS OF WISCONSIN. *The Taxonomy, Ecology, and Distribution of the Leguminosae Growing in the State Without Cultivation.*

By Norman C. Fassett. Drawings by Richard I. Evans, and a Study of Epidermal Outgrowths by Catherine Mose. University of Wisconsin Press, Madison. $3.00. 10 x 6¾; xiii + 157; 1939.

This scholarly work is the result of an enormous amount of observation and study, both in the field and in the museum. Fassett has presented a very complete list of the Leguminosae of Wisconsin, and has discussed these plants in relation to their taxonomic characteristics and their distribution. The key for identification is very detailed, yet quite simple and understandable. The text is well supplied with photographs of plants and charts showing the geographic distribution of the different species. In addition to the index and glossary, the volume contains a number of carefully prepared drawings, many of which were made from living forms.

The short section by Miss Mose on epidermal growth of the Leguminosae of Wisconsin concludes this body of practical and valuable botanical data.

A Fundamental Approach to Bacteriology.

By Courtland S. Mudge and Floyd R. Smith. J. W. Stacey, Inc., San Francisco. $2.50. 8½ x 5½; vii + 265; 1939.

This book is the outgrowth of the authors' search "to find a logical method for the teaching of general bacteriology." The experiments were devised in "an attempt to eliminate the minimum in the interest curve" and the text planned "to orient the student from that which has just been accomplished to that which is yet to be done." While not reaching quite the status of a regular textbook it is much more than a manual, although the flexible covers and wired-in pages give it the appearance of such. There are some lengthy excerpts from the Manual of Methods, the two Standard Methods of the American Public Health Association, and from Bergey, "to acquaint the student with such officialdom." A list of 102 important books on various phases of bacteriology is included, also an index.

Recherches sur le Gnomonia Ulmea (Schw.) Thüm. (*Biologie—Écologie—Cytologie*). *Contributions de l'Institut Botanique de l'Université de Montréal. No. 31.*

By René Pomerleau. Institut Botanique, Université de Montréal, Montréal. $1.00. 9 x 6; 139 + 30 plates; 1938 (paper).

Hitherto little has been known of the complete life cycle of *Gnomonia ulmea*, a fungus which attacks the elm, particularly the American species. In this book the author presents the results of an extensive study, showing that it undergoes all its developmental stages on its host (the fungus is strictly obligate to the elm), and fills some of the gaps in the knowledge, especially that concerning sexual determination. The book is illustrated with photographs and schematic drawings to show the different phases in the life cycle of *Gnomonia* and stages of leaf disease, and charts showing the effects of temperature, humidity, etc., on number of lesions on the leaf. The bibliography contains 78 titles.

This work was originally published in the *Naturaliste Canadien* from November 1937 to October 1938.

Wildfowl Food Plants. *Their Value, Propagation, and Management.*

By W. L. McAtee. Collegiate Press, Ames, Iowa. $1.50. 8 x 6; ix + 141; 1939.

The conservation of our wild ducks, swans, and geese is greatly concerned with their food habits. The results of numerous stomach analyses have made it possible to determine the preference of various wildfowl for certain plants. The method of propagating these food plants, the environmental factors affecting them, and the methods by which man can utilize them to benefit the birds form part of the book. The plants are arranged according to families with a discussion in each group as to their value to the different species of fowl. This book should satisfy the demands of hunters, refuge owners, and game managers for authoritative knowledge on the subject.

Native Woody Plants of the United States, Their Erosion-Control and Wildlife Values. *U. S. Department of Agriculture. Miscellaneous Publication No. 303.*

By William R. Van Dersal. Government Printing Office, Washington. $1.75. 9 x 5¾; ii + 362 + 44 plates + 3 folding charts; 1938.

In the words of the writer

> to carry out a program of soil and wildlife conservation vegetation must be utilized intelligently. Where considerable numbers of plants are to be employed, it is essential to know as much as possible about every species of tree, shrub, or herb we propose for planting." . . . "This publication presents an indexed list of woody plants growing in the United States, naming each species as unmistakably as possible, and giving all available data pertinent to its use in erosion control and wildlife conservation.

Two large maps showing climatic provinces and important soil areas in relation to plant growth regions are supplements to this publication.

Handbuch der Biologischen Arbeitsmethoden. *Lieferung 479. Abt. XI, Chemische, physikalische und physikalisch-chemische Methoden zur Untersuchung des*

Bodens und der Pflanze, Teil 4, Heft 8 (Schluss). Ernährung und Stoffwechsel der Pflanzen. Containing the following article: *Bestimmung der Transpiration und Evaporation mit Rücksicht auf die Bedürfnisse der Ökologie*, by Erich Leick.

Urban and Schwarzenberg, Berlin. RM. 14.50; (25 per cent reduction outside of Germany). 10 x 7; 194; 1939 (paper).

In this *Lieferung* the different methods and instruments that have been utilized by different workers in the determination of transpiration and evaporation in plants are described and illustrated, together with discussions of their advantages and disadvantages. Climatic factors influencing air and water economy of plants receive consideration. The bibliography covers 7 closely printed pages. The number also contains the complete index for Abt. XI, Part 4 of this handbook, and the table of contents of Abt. XI, Part 4.

POISONOUS PLANTS OF THE UNITED STATES. *By Walter C. Muenscher. The Macmillan Co., New York.* $3.50. 8½ x 5¾; xvii + 266; 1939.

The first part of this book is a general and brief consideration of poisonous plants, their nature and conditions under which they cause poisoning. The second and more extensive part consists of a detailed treatment of various plants by families. Here each plant is individually described, its distribution and habitat given and its conditions of poisoning discussed. The text is lavishly illustrated with clear black and white drawings and there is a long and complete bibliography and index.

COMMON EDIBLE AND POISONOUS MUSHROOMS OF SOUTHEASTERN MICHIGAN. *Bulletin No. 14.*

By Alexander H. Smith. Cranbrook Institute of Science, Bloomfield Hills, Mich. 50 cents (paper); $1.00 (cloth). 9 x 6; 71 + 16 plates; 1938.

There is no rule-of-the-hand method of distinguishing poisonous from nonpoisonous mushrooms. Hence this small book, teaching how to identify edible species and when and where to find them, is a boon to mushroom enthusiasts. Even the best of us aren't infallible apparently, for directly following a list of recipes prepared by his wife, the author has inserted a short section on what to do for mushroom poisoning. An index, glossary and numerous photographs should make this book suitable for use in the field by the amateur collector.

INDEX TO NORTH AMERICAN FERNS. *Constituting a Catalogue of the Ferns and Fern Allies of North America North of Mexico, Including All Known Forms, Varieties and Hybrids.*

Compiled and Edited by Maurice Broun. Foreword by Charles A. Weatherby. Available from the author, Hawk Mountain Sanctuary, Route 1, Orwigsburg, Penna. $2.50. 7½ x 5¼; 217; 1938.

This authoritative check-list giving the numerous forms, varieties and hybrids of North American ferns with references to texts wherein they are published and described, and including ecologic and geographic data for each species, is destined to become the outstanding guide for students of ferns in the United States and Canada. In taxonomy, the author follows Christensen as much as possible. Included in the volume is a tabular arrangement of the ferns and fern allies listed in the book, a list of authorities cited and an index (37 pages) to scientific names, with synonyms in italics.

AN INTRODUCTION TO BOTANY, *With Special Reference to the Structure of the Flowering Plant.*

By J. H. Priestley and Lorna I. Scott. Illustrated by Marjorie E. Malins and Lorna I. Scott. Longmans, Green and Co., New York, London and Toronto. $6.00. 8½ x 5¾; x + 615; 1938.

This excellent text for advanced work in plant physiology (green plants only) has undergone the necessary revision and additions in order to bring it up to date (first edition appeared in 1931). The

questions that concluded each chapter in the first edition have been omitted in order to conserve space. The lengthy bibliographies following each section and the detailed author and subject indexes help to make this a useful laboratory guide.

THE FUNGI OF MANITOBA AND SASKATCHEWAN.

By G. R. Bisby, with the Collaboration of A. H. R. Buller, John Dearness, W. P. Fraser, and R. C. Russell. Preface by H. T. Güssow. National Research Council, Ottawa, Canada. $3.50. 10 x 6¾; 189 + 13 plates + 1 folding map; 1938.

This list is not to be confused with *The Fungi of Manitoba* published in 1929 by three of the present authors. This is an entirely new check-list and includes the two provinces of Manitoba and Saskatchewan. There is an index which lists the fungi under their hosts in addition to the regular taxonomically arranged list. Locality records, dates, and hosts are included after the name of each species.

HUMUS. *Origin, Chemical Composition, and Importance in Nature. Second Edition Revised.*

By Selman A. Waksman. Williams & Wilkins Co., Baltimore. $6.50. 9 x 6; xiv + 526; 1938.

This edition is essentially the same as the earlier volume (cf. Q. R. B., Vol. 11, No. 3) except that the eighth chapter (Humus formation in composts of stable manures and of plant residues; green manures) has been considerably enlarged, and a new chapter, XVIII: Humus and soil conservation, has been added. Wherever necessary the text of the earlier edition has been revised, and, so far as possible, results of recent studies have been added.

PLANT CHEMICULTURE. *A Guide to Experiments in Growing Plants Without Soil. Third Edition, Revised and Enlarged. By C. D. Dawson and M. V. Dorn. Dawson and Dorn, 4613 West Washington Blvd., Los Angeles, Calif.* $1.00. 8½ x 5¼; 130; 1939 (paper).

This edition (cf. mention of second edition in Q. R. B.: 13, p. 471) has been somewhat enlarged by the inclusion of new textual material and some new photographs.

SILVA FENNICA 46. *Metsänhoitajien Jatkokurssit. [Der Fortbildungskursus für Forstmeister 1937. III.]*

Society of Forestry in Suomi, Helsinki. 9⅝ x 6½; [4] + 244; 1938 (paper).

ACTA FORESTALIA FENNICA 43. *Suomen Metsätieteellinen Seura—Finska Forstsamfundet.*

Society of Forestry in Suomi, Helsinki. 9⅝ x 6½; 356 + 20 plates; 1938 (paper).

MORPHOLOGY

OH, DOCTOR! MY FEET!

By Dudley J. Morton. D. Appleton-Century Co., New York and London. $1.50. 7⅜ x 5; ix + [7] + 116 + 7 plates; 1939.

The underlying theme throughout this work is that our lack of knowledge concerning the structure as related to the functional activity of the foot has been responsible for the lack of attention paid to foot troubles by most of our general practitioners. As a result, foot ills have all been referred to the shoe specialist, with the consequence that the unenlightened sufferer soon finds himself with a closet full of expensive shoes, and feet that are in as bad a condition as (if, indeed, not worse than) they were in the beginning.

Dr. Morton stresses the use of the X-ray in determining the underlying causes of ailing feet, and suggests many scientific modes of approach in effecting a cure, none of which, oddly enough, includes specially built shoes. The general practitioner will find much in this little volume which will be of extreme value to him in meeting the ever-growing line of sufferers from common foot ailments.

LA MÉDECINE MORPHOLOGIQUE.

By A. Thooris. G. Doin and Cie, Paris. 55 francs. 10½ x 7¼; iv + 291; 1937 (paper).

Thooris devotes this monograph to a lengthy statement of his philosophical ideas on the study of constitutional somatology and its significance as a foundation for a biological approach to the study of problems of health and disease. He emphasizes the need for a synthetic view of the individual and regards the study of somatology as a means of arriving at this synthesis since the external morphology is related to that of the internal organs and is, besides, the expression of ontogenetic and philogenetic development. In the main, he elaborates the concepts that characterize the classical French school of constitutionalists, and the classification of morphologic types which he adopts and uses as basis for discussion primarily follows that of Sigaud and the more recent modifications of Baron. In treating of the physiological and pathological variations associated with the several body types the author limits himself to advancing a number of hypotheses that are rational extensions of ideas set forth by Claude Bernard and Pavlov. These hypotheses constitute the substance of this book and while they have no factual foundation they result from a long clinical experience and therefore deserve attention.

ANATOMIA DEL NEONATO.

By Francesco Bellelli. Preface by Giunio Salvi. G.U.F. "Mussolini Sezione Editoriale," Naples. 30 lire. 9¾ x 7; [6] + 229; 1938 (paper).

The author's premise is that the anatomy of the newborn—birth to one–two days of extra-uterine life—has important characteristics which differentiate it from the infant and, of course, from the foetus. Therefore, in this monograph he summarizes the anatomical traits peculiar to the newborn as observed by himself and others. Briefly but clearly he describes in the usual textbook order the osteology, myology, angiology, and splanchnology of the newborn, and besides, discusses in some detail the nervous and endocrine systems. Although the author has limited himself mostly to a survey of the observations reported by continental investigators, the descriptions are fairly complete and one finds emphasized many interesting anatomical features that usually receive only passing notice in the textbooks.

LES PROGRÈS RÉCENTS DE L'EMBRYOLOGIE EXPÉRIMENTALE.

By Maurice Caullery. Flammarion Éditeur, Paris. 22 francs. 7½ x 5⅛; 236; 1939 (paper).

The rapid strides which have been made in experimental embryology, a field about which little is known by the intelligent public, has prompted Caullery to publish this book. It does not pretend to cover the entire field, but presents the more important advances clearly defining all necessary terms.

Considerations of normal development and its study by using colored marks, are followed by studies on fragmentation of eggs and subsequent fertilization of the parts. Embryonic grafts, organization, and induction are discussed at some length. Very little treatment is given to mammalian forms, the material being largely confined to echinoderms, insects, amphibia, fish, and birds. Frequent drawings illustrate experimental techniques and results obtained.

TEXTBOOK OF NEURO-ANATOMY AND THE SENSE ORGANS.

By O. Larsell. D. Appleton-Century Co., New York and London. $6.00. 9¾ x 6½; xii + 343; 1939.

A text for first year medical students—the outgrowth of the author's experience in teaching neuro-anatomy. The general treatment has been by functional systems, considerable emphasis being placed on functional aspects of the various divisions of the nervous system. The entire presentation is "to aid the student to think as early as possible in terms of functional anatomy." Brief descriptions of lesions

in various parts of the nervous system are included at the end of some chapters. The volume is profusely illustrated, bibliographies conclude the chapters and there is an adequate index.

ELEMENTARY ANATOMY AND PHYSIOLOGY. *By James Whillis. Foreword by T. B. Johnston. Lea and Febiger, Philadelphia.* $3.50. 9¼ x 6⅛; ix + 342; 1939.

This text has been written for elementary students in order that

> the combination of Anatomy with some simple Physiology will make the study of the structure of the body more interesting and profitable to the student during his first year of Medicine. The physiological matter included is not intended to trespass in any way on the function of the existing elementary text-books of Physiology, but is limited to the essentials of function.

The illustrations (87) are of semi-diagrammatic type and the index is adequate. The author is at present University Reader in Anatomy, Guy's Hospital Medical School.

THE FETAL PIG. *An Introduction to Mammalian Anatomy. By Hazel E. Field. Stanford University Press, Stanford University, Calif. Oxford University Press, London.* 75 cents. 8½ x 5½; ix + 53; 1939 (paper).

An excellent introduction to mammalian anatomy for those students whose acquaintance with the dissecting room will terminate with the final examination in the introductory course. The fetal pig is selected for its similarity in structure to the human body and ease in dissection. Fetal pigs may easily be procured at little or no cost from slaughterhouses. There is a brief general bibliography for student reference. Glossary and index are combined.

SCHAFER'S ESSENTIALS OF HISTOLOGY. *Descriptive and Practical for the Use of Students. Fourteenth Edition. Edited by H. M. Carleton. Lea and Febiger, Philadelphia.* $5.00. 8½ x 5¾; xii + 618; 1938.

This book first made its appearance 53 years ago with Sir Edward Sharpey-Schafer as its author. The present edition still retains the general character of the earlier editions although *The Lessons*, the term used to denote the sections, have been revised and some of the older illustrations replaced by photographs. In an appendix is given in detail methods for preparing histological material. The volume contains many (over 650) excellent illustrations and a useful index.

PHYSIOLOGY AND PATHOLOGY

PHYSIOLOGIE DES ANIMAUX MARINS. *By Paul Portier. Flammarion, Éditeur, Paris.* 20 francs. 7½ x 5¼; 253; 1938 (paper).

This is a small book but between its pages is packed a tremendous quantity of information. The words "animaux marins" are construed very broadly so as to include not only the aquatic birds but even the mythical sea serpent.

The nutrition and respiration of marine animals is thoroughly covered. Also there are chapters on such diverse matters as both the natural and artificial culture of pearls, the effect of changes in salinity and pressure on organisms (there is a great deal about fresh-water forms of life covered under this heading), the methods of obtaining material from great depths, the use of the bathysphere, the use of helium to prevent divers from being overcome by "the bends," protective coloration and mimicry, the operation of the chromatophores, etc., and the evolution of living matter. There is no empiric evidence of the creation of life; according to this author living matter, like Topsy, "just growed."

The author draws a fine distinction between poisonous and venomous—it seems that a poisonous animal is one like a snake that is actively poisonous, but a venomous animal is one like certain mussels whose fluids contain so much iodine, bromine, or copper that they passively poison any predator who eats them. Among the actively poisonous animals are the *Cnidaria* that are provided with nematocysts, but there are many forms of

animals not naturally provided with these weapons that obtain them from the original owners. Some crabs detach actinians and plant them on their own carapaces, and some cephalopods are provided with gelatinous cylinders covered with nematocysts which seem to be of coelenterate origin, but how the cephalopods obtain possession of them is not clear. The chapter dealing with locomotion is perhaps the most readily comprehended, since this function is so easily observed. The various forms of locomotion are described and compared, from the ciliary action of the lower plankton to the wings of the penguin which are so modified for swimming that these birds can no longe fly.

This otherwise highly meritorious book has no index. This is unfortunate, for a detailed compendium such as this work is needs one. The bibliography contains 87 entries, but it is clear that the author must have consulted many more sources than these in fitting himself for the preparation of such a book.

IMMUNITY. *Principles and Application in Medicine and Public Health. Fifth Edition of "Resistance to Infectious Diseases."*

By Hans Zinsser, John F. Enders and LeRoy D. Fothergill. The Macmillan Co., New York. $6.50. 9¼ x 6⅛; ix + 801; 1939.

The story of the extraordinarily rapid growth of the science of immunology is told in the successive changes which this work has undergone. The present volume is the fifth edition of the work first published in 1914 under the title "Infection and Resistance." The first three editions appeared under the same title, although each was revised and reset. In 1931 the fourth edition appeared, called "Resistance to Infectious Diseases." The latest volume, published this year, more than any of its predecessors marks the change "from the trial and error method of pure biology" to "the application of methods of physics and physical chemistry" in immunology. An evolution has also occurred in the circle of readers. A quarter of a century ago, although the medical student was interested, the practicing physician did not yet consider the principles of immunology to be of much actual concern to him. Today the clinician has taken these principles out of the laboratory, and their applications are some of his most effective tools.

In the first half of the 1939 edition Zinsser and his collaborators present a synthesis of what is known "of the biological phenomena of infection and recovery in the animal body." The latter part considers the application of the principles evolved in the earlier section "to diagnosis, treatment, and prophylaxis, and their usefulness in the control of epidemics." Specific diseases are considered in their relation to the principles of immunity, including syphilis and tuberculosis, whooping cough, and protozoan infections, as well as diphtheria, scarlet fever and other hemolytic streptococcal infections.

The senior author holds a unique position of authority in the field of immunology, and his treatment of the subject includes consideration of the most recent developments.

PHYSIOPATHOLOGIE DE LA VIEILLESSE *et Introduction a l'Étude des Maladies des Vieillards.*

By P. Bastai and G.-C. Dogliotti. Masson et Cie,, Paris. 50 francs. 9¾ x 6¾; 235; 1938 (paper).

Senility according to the authors' definition, is the period of life in which there is an organic and functional involution characterized by a predominance of the regressive and destructive processes over the constructive phenomena. They take the position that senility is a condition or disease *sui generis* that exists independently of other pathological states and they emphasize the distinction between the physiological and pathological changes that are peculiar to senescence from the diseases, such as arteriosclerosis, which very often accompany old age. In the first section of the monograph, they present the summary of a mass of observations, their own and of others, regarding the anatomical and functional conditions observed in the various organs and organ-systems of the aged. They conclude after

a thorough survey that the characteristics of senility result practically always from alterations in the capillary system. The evidence to support such a view while not definitive appears adequate, and, as the authors note, this conclusion is not contradicted by the views of other students of the subject. In the second part of the book the authors discuss the manifestations of acute and chronic diseases in the aged and the interpretation of the courses of these diseases in terms of their conclusion. The authors have approached their study in a true empirical fashion and although many hypotheses involving elegant theorization have been advanced about senility, the conclusion reached by the authors, limited as it is in philosophical scope, is worthy of serious consideration on its merits alone quite aside from the eminence of those who have conceived it.

ALCOHOL IN MODERATION AND EXCESS. *A Study of the Effects of the Use of Alcohol on the Human System.*

By J. A. Waddell and H. B. Haag. William Byrd Press, Richmond, Va. $1.00. 9 x 6¼; 184; 1938.

This comprehensive treatise on the relation of alcohol to the physiological and psychological activities of the body was prepared at the request of the Virginia State Legislature. After it was carefully completed by the committee of eight medical men from the medical faculty of the University of Virginia, and the Medical College of Virginia, it was referred to the Senate to be printed as a Senate Document, but was rejected as a result of strong opposition by a dry block in the legislative body. The opposition came, in all probability, because the report did not give all the orthodox answers to the questions concerning the use of alcohol on the body.

The general conclusion is reached that alcohol in moderation produces very few of the effects it is generally accused of producing; but, on the other hand, its use in excess is responsible for all the effects it is accused of, and more besides. Stress is placed on the effect of excessive alcoholism in habit forming, degrading of social and moral standards, and in the deterioration of body and mind. The study is based on a thoroughly scientific approach rather than a moral one, and is presented in a scholarly and authoritative manner.

L'OPERA DEL COMITATO ROMANO PER L'ASSISTENZA ANTIMALARICA DAL 1921 AL 1935.

Comitato Romano per l'Assistenza Antimalarica. Tipografico Luigi Proja, Rome. 10⅜ x 7; 95 + [5] + 32 plates + 2 folding maps; 1938 (paper).

This is the official account of one aspect of the anti-malaria campaign conducted from 1921 to 1935 in the rural section of the Roman region of Italy. The whole program as developed has consisted of health propaganda utilizing movies, literature and speakers, reclamation of the land by irrigation and similar means, and finally, the introduction of mobile dispensaries to distribute quinine for prophylaxis and for treatment, as well as to make epidemiological studies. The report is concerned primarily with the third type of activity. It describes the organization of the health units, the means adopted to get the cooperation of local physicians, of the farm-workers and of the landowners, the quinine compounds used and the results of laboratory examination of blood plasma. In addition, it presents statistics on the number of persons treated each year and the number of new and old cases. The results have been gratifying. Annually there has been a perceptible reduction in the number of cases of malaria and moreover the benefits of quinine as a prophylactic have been definitely realized and understood by the people. Whether the decline of malaria will continue once the intensive and, of course, costly campaign is abandoned can only be learned in the future. In the meantime, the reclamation of the land has progressed rapidly enough and as everyone knows, thanks to efficient government news service, thriving communities stand today where there were formerly only marshes. So, temporarily at least, the campaign may be considered successful.

THE BIOLOGY OF THE CELL SURFACE. *By Ernest E. Just. P. Blakiston's Son and Co., Philadelphia.* $5.50. 9 x 6; xi + 392; 1939.

If one were to designate the biological category into which this book most naturally falls, doubtlessly it would be the field of general physiology; but certainly the book is not a conventional account of the physiology of protoplasm, or even of a part of this field. It is a monograph on *ectoplasm.* "In all cells of . . . animals, the existence of the ectoplasm can be demonstrated"—so the author states in the opening of his summary. The ectoplasm is the superficial region of the protoplasmic ground-substance, and Just believes that it differs from the endoplasm in its special properties. The book deals with phenomena of conduction, contraction, respiration, the intake and output of water—these being general properties of all animal cells—but also, and more specifically, it discusses the mechanisms of fertilization, parthenogenesis, cell-division, and development in animal eggs. "The reactions underlying both differentiation and heredity" are "shown to be under the domination of cytoplasmic reactions resulting from the interplay of both ectoplasm and nucleus with the cytoplasm." The philosophical implications of Just's theory are discussed at some length.

MEDICAL AND SANITARY REPORTS FROM BRITISH COLONIES, PROTECTORATES AND DEPENDENCIES FOR THE YEAR 1936. *Tropical Diseases Bulletin, Vol. 35, Supplement, November, 1938.*

Summarized by P. Granville Edge. Bureau of Hygiene and Tropical Diseases, London. 7s. 6d. 9½ x 6; 296; 1938 (paper).

Anyone who has had occasion to turn to medical reports of colonial officers will appreciate this, the eighth annual summary of the reports from the British colonies. Although not every report is complete, a wealth of information about vital statistics, incidence and distribution of various diseases, public-health administration, etc., is given. Since the majority of the colonies are tropical or semi-tropical, the so-called tropical diseases predominate. As a picture of the British colonial medical service in action, or as an index to the various reports, the summary is invaluable.

Especially interesting is the 16-page article entitled, "The incidence and distribution of human trypanosomiasis in British Tropical Africa." The author has brought together, from all of the reports, the data on human trypanosomiasis, discussing it under the headings, incidence and geographical distribution, preventive measures, treatment, and research.

PROBLEMS OF AGEING. *Biological and Medical Aspects. A Publication of the Josiah Macy, Jr. Foundation.*

Edited by E. V. Cowdry. Williams & Wilkins Co., Baltimore. $10.00. 9 x 6; xxx + 758; 1939.

As the proportion of the aged in the population increases, gerontology will eventually become a far more intensive enquiry. A worthy contribution in this direction is made by this symposium which contains articles by 25 noted biological and medical scientists. The main purpose of the publication is to focus attention on the several theoretical and practical aspects of the processes of ageing. The authors in general have given a thorough review and summary of the existing knowledge in the fields they treat. The first four articles deal with a discussion of ageing phenomena in plants, protozoa, invertebrates and vertebrates. In two articles that follow, anthropological and demographic considerations are presented. Then there are articles concerning the pathology and physiology of the various organs and organ-systems in relation to age and the psychological and psychiatric aspects of the problem. The viewpoints developed and the conclusions reached point to the fact that greater knowledge of the biology and biochemistry of ageing phenomena is needed and that psychological and social factors are involved to a greater extent than has heretofore been realized. Notwithstanding the many questions dis-

cussed here, it is only too obvious that not all the problems have been noted. It is hoped that this book will serve to stimulate further study.

A Medical Survey of the Republic of Guatemala.

By George C. Shattuck, with the collaboration of Joseph C. Bequaert, Margaret M. Hilferty, Jack H. Sandground and Samuel D. Clark. Carnegie Institution of Washington, Washington, D. C. $2.50 (paper); $3.00 (cloth). 11½ x 9; xi + 253 + 2 folding maps; 1938.

This is a report of a survey, organized by the Department of Tropical Medicine of the Harvard School of Public Health and carried out in 1932 under the auspices of the Carnegie Institution of Washington. Margaret M. Hilferty has contributed chapters on the vital statistics of Guatemala and a statistical study of morbidity and mortality at Quirigua from 1919 to 1931; S. D. Clark, one on diseases of the Peten District of Guatemala; Jack H. Sandground, one on helminthic infections of man; and Joseph C. Bequaert, two chapters, one on the Arthropoda of medical importance in Guatemala and the other on the distribution of *Phlebotomus* in Central and South America. The major part of the work is the contribution of George C. Shattuck who outlines the history, probable origin and incidence of the infectious diseases of Guatemala and gives a more detailed study of malaria, chiclero ulcer, syphilis and yaws, aenemia, goitre, myxoedema and cretinism, circulatory and renal disorders, etc.

Nearly all the separate chapters include a list of references. The book is indexed and is illustrated with 5 graphs and three maps.

Landmarks in Medicine. *Laity Lectures of the New York Academy of Medicine. New York Academy of Medicine.*

Introduction by James A. Miller. D. Appleton Century Co., New York and London.

$2.00. 7½ x 5⅛; viii + 347; 1939.

The New York Academy of Medicine annually invites the public to attend a series of lectures. This book, incorporating the discourses of one such series, may further a growing understanding between the doctor and those whom he serves.

Alfred E. Cohn presents an interesting discussion of medical research which, he says, must be a serious undertaking with ample equipment and just rewards, but subject to free criticism. The reader is given an insight into the medico-legal aspect of crime detection by Harrison Martland. He discusses critically the merits of the medical examiner's system as opposed to the coroner's office. "The Search for Longevity," a subject of universal interest, is treated by Raymond Pearl. Both hereditary and environmental factors are considered, and particularly the influence of alcohol, tobacco, and work. One of the pioneers in the field of X-ray, Dr. Lewis Gregory Cole, tells in a personal manner about the difficulties which had to be overcome before the X-ray assumed its present position of high diagnostic value.

Iodine and the Incidence of Goiter.

By J. F. McClendon. University of Minnesota Press, Minneapolis; Oxford University Press, London. $5.00. 11 x 8⅝; vi + [4] + 126; 1939.

This scholarly contribution is the result of many years' work in the collecting and classifying of data concerning the geographical distribution of iodine and its relation to the incidence of goiter. The work has occupied the interest of the author for nearly 30 years, and has taken him to many corners of the earth. McClendon has made no attempt to include such topics as the anatomy of the thyroid gland, or the classification of goiter, or any of the phases of the medical treatment of goiter; but has confined his discussions to the geographical distribution of iodine, its place in the field of nutrition, and its relation to the incidence of goiter. The text contains numerous tables and figures which are effective in demonstrating the undeniable relationship between iodine insufficiency and thyroid abnormalities.

A chapter on iodine determination, an author index, and a subject index conclude the book.

HEALTH AT FIFTY.

Edited by William H. Robey. Harvard University Press, Cambridge. $3.00. 8 x 5½; x + 299; 1939.

The aim of the lectures which make up this book . . . is to clarify, explain, and interpret the recent developments in various departments of medicine and medical research, to warn of unsuspected dangers, and to stress the necessity of seeking sources of skilled advice rather than temporizing, depending on personal interpretation of symptoms, or tampering with drugs, techniques, or cults which have neither efficacy nor scientific basis.

The authors of these twelve essays are from the faculty of Harvard Medical School. They present their topics in non-technical language, easily understandable to the layman. The volume largely confines itself to later life disorders such as cardiovascular diseases, cancer, arthritis, and the menopause. Among topics not defined by age limits there are sensible discussions on weight abnormalities, care of the eyes and mental health. A lecture entitled "The Family Medicine Cabinet" will be a revelation to homemakers.

LE CANCER.

By Gustave Roussy. Librairie Armand Colin, Paris. 15 francs (paper); 17.50 francs (cloth). 6¾ x 4½; 224; 1939.

Although this little book has been written for the layman, it contains so much information and is so up-to-date that it can be of interest even to the medical reader. Roussy's idea was to give to the public some notion of the tremendous amount of cancer research which has been done in recent years, if only so that they would come to see that physicians are not so entirely hopeless or so entirely ignorant about the disease as they once were. Once the layman comes to realize this he will perhaps be less likely, when he finds himself afflicted with cancer, to throw up his hands in despair or to go to a quack.

In the final chapter Roussy reviews briefly what the governments of the several civilized countries of the world are doing in the way of combatting cancer.

VACCINATION CONTRE LA SÉNESCENCE PRÉCOCE.

By C. Picado. Preface by Professor Caullery. Librairie E. Le François, Paris. 22 francs. 8⅞ x 5½; 240; 1937 (paper).

Searchers for the fountain of eternal youth never dreamed of its emanating from anything as small as a hypodermic syringe. Old age is thought of by the author as a disease, and as such we shall be able to immunize against it if we can find and properly apply a vaccine. Accordingly, after a brief treatment of reproduction and growth, he deals with the causes of senescence and arguments against the possibility of rejuvenation. Hormonal cycles and age differences in the chemistry of the body and blood serum may furnish the key to the problem. Picado discusses these factors and then presents results of experimental life prolongation in lower forms. The treatise ends with considerations of the short and long lived races of animals. An extensive bibliography is included.

FUNDAMENTALS OF PHYSICAL EXAMINATION.

By George G. Deaver. W. B. Saunders Co., Philadelphia and London. $2.75. 7¾ x 5¼; 299; 1939.

The various techniques used in physical examination together with pathological findings in the various regions of the body are briefly described in this book which is designed for the physical educator rather than the physician. The information presented is, on the whole, highly superficial, with the inclusion of useless detailed medical verbiage. The presentation is academic, each chapter being followed by Lessons to be Written, Laboratory Work and Self-Tests. The bulk of the subject matter seems to lie far outside the functions of the physical educator who can hardly be expected to acquire more than a dangerous mite of knowledge, or a false confidence in his diagnostic ability, from even complete mastery of this book. A glossary of medical terms and an index are included.

LE CORPS JAUNE. *Étude biologique, clinique et thérapeutique.*

By H. Simonnet and M. Robey. Preface by L. Portes. Masson et Cie, Paris. 50 francs. 9¾ x 6¾; 171; 1939 (paper).

This book divides into two parts: I. Experimental study, including the formation and structure of the corpus luteum, biochemistry of lutein tissue, and chemistry of the luteinizing hormone, pharmaco-dynamic action of the corpus luteum extracts and hormones on the genital apparatus, particularly during pregnancy, physiological processes; II. Clinical study, including tests of the functional state of the corpus luteum, its pathology, and therapeutic uses of corpus luteum preparations in the treatment of menstrual disorders, sterility, abortion and menopause. The book is more a synthesis of the literature than a presentation of original work. Lengthy bibliographies end the individual chapters.

NUTRITION: THE NEWER DIAGNOSTIC METHODS. *Proceedings of the Round Table on Nutrition and Public Health. Sixteenth Annual Conference of the Milbank Memorial Fund, March 29–31, 1938.*

Milbank Memorial Fund, New York. $1.00. 9 x 6; 192; 1938 (paper).

With A. Graeme Mitchell and R. M. Wilder as chairmen, a group of specialists in several branches of the field of nutrition gathered at a round table conference called by the Milbank Memorial Fund in March, 1938. This report includes the papers presented at the meeting and the discussions that ensued. They deal with the use of roentgenology, electrocardiography, dark adaptation and hematologic tests in determining nutritional deficiencies and avitaminosis particularly. The articles are all informative and the lists of recent literature accompanying them are most useful.

THE EFFECT OF DIFFERENT PERCENTAGES OF PROTEIN IN THE DIET OF SIX GENERATIONS OF RATS. *Stanford University Publications. University Series. Biological Sciences, Volume VI, Number 4.*

By James R. Slonaker. Stanford University Press, Stanford University, Calif. Oxford University Press, London. $1.00 (paper); $1.75 (cloth). 10¼ x 7; 67; 1939.

This study aims to determine the approximate protein percentage in the diet for maintenance of the highest level of physiological performance in rats. Five different protein diets were fed to several groups of rats, and these groups were compared in activity, development, reproduction, and mortality, embodying 49 comparisons in all. No single diet was superior to the others in every one of the processes studied, but in the total series 14.2 percent protein was most efficacious, higher amounts being advantageous during reproduction. The writer suggests that with modifications his findings may be applicable to higher forms, since this percentage approximates certain standards recommended for man.

LE PHOSPHORE DES VÉGÉTAUX. *Son rôle dans l' énergétique cellulaire. I. Phosphore Minéral et Glucidique.*

By E. Michel-Durand. Presses Universitaires de France, Paris. 30 francs. 10 x 6½; viii + 99; 1939 (paper).

The author divides the phosphorus found in plants as follows: phosphates and pyrophosphates (mineral P), phosphoglucide esters (glucide P), phosphatides (lipid P) and nucleoproteides and derivatives, the phosphoproteids (protid P), most of which are also found in animals. This book treats the first two; the others will be dealt with in later volumes. The three chapters concern mineral phosphorus, glucide phosphorus and phytine, giving for each the amount and distribution in the parts of the plant, methods of extraction and preparation, properties and biological rôle. There is a bibliography but no index other than a detailed table of contents.

ZUR NORMALEN UND PATHOLOGISCHEN ANATOMIE DES GREISENALTERS.

By Ludwig Aschoff. Urban and Schwarzenberg, Berlin and Vienna. RM. 2.50; (25 percent less outside of Germany). 9 x 6; 116; 1938 (paper).

This is a collection of papers originally published in the weekly *Medizinische Klinik.* The author, himself one of the leading German pathologists, gives an

admirable short and precise review on the physiological changes in senility. He describes one after the other, the most important changes in all the different organ systems—mostly from the pathological-anatomical point of view. Statistical methods and life table experiences are scarcely mentioned. However, the statistics of causes of death in old age (over 65 years) on the basis of personal experience with 400 cases, post-mortem examinations in Freiburg, are included.

BIOLOGY FOR PHARMACEUTICAL STUDENTS AND OTHERS.

By S. Mangham and A. R. Hockley. William Wood and Co., Baltimore. $6.50. 8½ x 5⅝; vii + 613; 1938.

This book "is designed primarily to meet the requirements in Biology of students preparing for the Preliminary Scientific Examinations of the Pharmaceutical Society of Great Britain." Quite apart from this special feature, the fundamental principles of biology, as well as the more important physiological principles are treated in considerable detail so that the book can well be used in general biology courses. Most of the illustrations (299 figures), nearly all of which have been prepared by the authors, are partly diagrammatic in order to serve the student as a guide to his own observations. There is an adequate index.

FUNDAMENTALS OF EXPERIMENTAL PHARMACOLOGY. *Second Edition.*

By Torald H. Sollmann and Paul J. Hanzlik. J. W. Stacey, Inc., San Francisco. $4.25. 9 x 6⅛; 307; 1939.

This second edition has been completely revised to include new material in line with recent advances in the field of pharmacology. Obsolete matter has been deleted. The text is divided into two parts; chemical pharmacology and experimental pharmacodynamics, each containing practical exercises and tested methods. The material is so arranged that the experimental work can be given as an independent course, or integrated with a course of systematic lectures. There are several valuable appendices, a bibliography and an index.

PRINCIPLES OF HEALTH EDUCATION. *Second Edition.*

By C. E. Turner. D. C. Heath and Co., Boston. $2.00. 7¾ x 5½; xvi + 335; 1939.

This is a short but comprehensive textbook dealing with health education, its relation to general education and to public health. It gives a well-planned program of health instruction and is designed for school teachers, school physicians and other persons concerned with health education and health training.

DIETS OF FAMILIES OF EMPLOYED WAGE EARNERS AND CLERICAL WORKERS IN CITIES. *U. S. Department of Agriculture. Circular No. 507.*

By Hazel K. Stiebeling and Esther F. Phipard. Government Printing Office, Washington. 15 cents. 9¼ x 5¾; 141; 1939 (paper).

An analysis of the content, cost and nutritive adequacy of diets of wage earners and clerical workers. It is based on dietary records covering one week each, obtained during the period December 1934–February 1937, in 43 industrial centers in 8 major geographical regions of the United States. About 4,000 records were analyzed. The data (presented in 70 tables) are so arranged as to be useful to other workers in this field. There is a bibliography of 68 titles.

LA PONCTION STERNALE. *Procédé de Diagnostic Cytologique.*

By P. Emile-Weil and Suzanne Perlès. Masson and Cie, Paris. 75 francs. 10 x 6½; 183 + 6 plates; 1938 (paper).

Drs. Émile-Weil and Perlès have here produced an interesting volume, beautifully illustrated with colored plates, showing the diagnostic help that can come from puncturing the sternum and studying

stained smears made from the marrow. The method helps in recognizing submerged leukemias and some of the syndromes in which there is an excessive production of erythrocytes. The book will be of interest to hematologists.

STUDIES ON PROLONGED PREGNANCY IN RATS.

By Finn Bøe. Levin and Munksgaard, Copenhagen. Kr. 10. 10 x 6¾; [8] + 146; 1938 (paper).

A strain of highly inbred rats were carefully studied as to the results of delayed parturition. The delay was caused by three different methods: administration of gonadotropic hormones, mechanical stricture of the uterine horns, and hypophysectomy. The investigation shows the effect of this upon the mechanism of birth, the fetus, the placentae, and the endocrine organs. Of particular interest are the rôles of estrone and progesterone.

HANDBOOK OF MICROSCOPIC CHARACTERISTICS OF TISSUES AND ORGANS.

By Karl A. Stiles. (Copies obtainable from the author, Coe College, Cedar Rapids, Iowa.) $1.50; discounts for quantity orders. 11 x 8½; [6] + 59; 1939 (paper).

This handbook is the expansion of a former outline "Aids to the microscopic identification of tissues and organs." Each topic is presented in condensed form with salient points, in some cases arranged in chart form. The value of the outline would seem to be in its usefulness as a syllabus in connection with textbooks of histology.

PHYSIOLOGY OF MUSCULAR ACTIVITY. *Second Edition, Revised.*

By Edward C. Schneider. W. B. Saunders Co., Philadelphia and London. $3.00. 7½ x 5¼; 428; 1939.

The first edition of this volume appeared in 1933 and was reviewed in Vol. 9, No. 3 of this journal. For the second edition the text has been revised to conform with the knowledge of today and some new material and a glossary have been added increasing its size by 28 pages.

THE CHEMISTRY OF NATURAL IMMUNITY.

By William F. Koch. Christopher Publishing House, Boston. $2.00. 7⅞ x 5⅜; 199; 1938.

A presentation of the development of, and the theory behind, the glyoxylide treatment of cancer, coronary occlusion, advanced arteriosclerosis, syphilis, epilepsy, and hay-fever. It is written by the originator of the treatment.

BIOCHEMISTRY

THE STUFF WE'RE MADE OF.

By W. O. Kermack and P. Eggleton. Longmans, Green and Co., New York; Edward Arnold and Co., London. $3.20. 7¼ x 5; viii + 342 + 8 plates; 1938.

This very readable and entertaining book (a book-of-the-month; Scientific Book Club) by two eminent biochemists of the University of Edinburgh interprets for the layman the science of biochemistry, which is defined in the words of the authors as "the meeting place of the animate and inanimate worlds." There are chapters on atomic bricks, molecular architecture, giant molecules, vitamins, enzymes, sex hormones and reproduction, growth, and other such pertinent subjects.

In the chapter entitled "A sense of proportion" the authors endeavor to give the reader a picture of the entire universe. This is done by means of a scale at the bottom of which is the proton and at the top of which is the universe with a weight of 10^{78} protons. Every object in the universe is within 0 and 78 with the exception of the electron which is on the negative side of the scale. Man appears at about 29. Somewhere from 6 to 9, the region called the colloidal range, the complex phenomena of life first appear.

HANDBOOK OF FOOD MANUFACTURE. *A Handbook of Practical Food Information,*

Containing Factory Tested Commercial Formulae and Descriptions and Analyses of Prepared Foods and Raw Materials.

By F. Fiene and Saul Blumenthal. Chemical Publishing Co., New York. $6.00. 9 x 6; vi + 603; 1938.

This book is written for the "manufacturer, chemist, plant superintendent, food buyer, and broker, in the baking, beverage, confectionery, condiment, essence, fruit juice, fruit, flavor, ice cream, preserving, spice, and allied food industries. As the title page indicates, a wide field is covered. Some of the material is technical; for example, the sections on chemistry of sugars, baking powders, tests and analyses of edible oils and fats, and action of nitric acid on different oils. On the other hand, there is much that the average individual can comprehend. A great deal of information is given about different kinds of cheese; directions are given for making flavoring extracts, artificial fruit oils and essences, and liqueurs; formulae for pie filling powders, and many kinds of cake, etc., such as the elaborate affairs one sometimes sees on display in the baker's window. The latter part of the volume is devoted to analyses and tests, weights and measures, common and chemical names of various materials, and definitions and standards for food products for use in enforcing the food and drugs act. In short, the volume is a sort of *vade mecum* for the manufacturer of food; but the compiler of cook books and those who write about food for newspapers and women's journals will also find it useful. An adequate index is provided.

EXPOSÉS ANNUELS DE BIOCHIMIE MÉDICALE. *Published under the direction of Michel Polonovski. Première Série by E. Aubel, E. J. Bigwood, P. Boulanger, P. Fleury, Ch.-O. Guillaumin, M. Javillier, M. Macheboeuf, M. Polonovski, Ch. Sannié, R. Wurmser and R. Wolff. Masson and Cie, Paris.* 75 francs. 9¾ x 6¾; 269; 1939 (paper).

This book is made up of a series of excellent articles on biochemical topics of immediate interest to practicing physicians. The articles seem to be up-to-date, and well worth reading. There are chapters on the production of, and excretion of ammonia, on the deoxydizing reactions of living organisms, on diastases, vitamins, and provitamins, on hormones, and on the transformation of glycogen into lactic acid in muscle. There is a fine article on the cancerogenic substances and another on the metabolism of the body invaded by cancer. There are articles on the serum proteins, on lipids, the metabolism of calcium, and the methods of adsorption of substances.

THE BULLETIN OF MATHEMATICAL BIOPHYSICS. *Volume 1, Number 1. Published as a Supplement to Psychometrika.*

Edited by N. Rashevsky. University of Chicago, Chicago. Subscription price $2.50 annually. 10 x 6¾; 73; 1939.

The *Bulletin*, published as a supplement to *Psychometrika*, is devoted to publications of research in mathematical biophysics, as contributing to the physico-mathematical foundations of biology. This number contains the following papers: Mathematical biophysics of cell respiration. II, by H. D. Landahl; Note on biological periodicites, by Alvin M. Weinberg; The mechanism of cell division, by N. Rashevsky; On the mechanics of viscous bodies and elongation in ellipsoidal cells, by Gale Young; Mathematical biophysics of the cell with reference to the contractility of tissues and amoeboid movements, by N. Rashevsky; Concerning Rashevsky's theory of the *Gestalt*, by A. S. Householder.

LA PRESSION COLLOÏDO-OSMOTIQUE DES LIQUIDES BIOLOGIQUES. *Travail des Laboratoires Auguste Lumière.*

By Paul Meyer. Imprimerie Léon Sézanne, Lyon. 30 francs. 9¾ x 6⅝; ix + 218; 1939 (paper).

Except for the last chapter this book is an objective presentation of the findings of many workers—the bibliography runs to 610 titles—on the physical chemistry and biological rôle of colloidal osmotic pressure of the body liquids in health and

disease. In the last chapter the author expresses his opinions gained from ten years' experimental work of his own. He disagrees with the concept advanced by Starling, namely that colloidal osmotic pressure is the regulator of tissue metabolism of the liquid, but returns to the classical theory that it is the expression of processes that occur in the tissues. There is no index, but a detailed table of contents.

SEX

HARMONY IN MARRIAGE.

By Leland F. Wood, with the help of Robert L. Dickinson. Round Table Press, New York. $1.00. 7 x 4¾; vi + 122; 1939.

In this little book, Mr. Wood has given lively verbal expression to one of the deepest set elements of his philosophy of life; namely, that a word in time often forestalls matrimonial shipwreck. This is surely one of the most worthy causes to which any man could dedicate his life, and the author is to be commended for the sincere and enthusiastic presentation of his experiences, his convictions, and his most wise council.

The obvious paradox associated with the dissemination of such knowledge as this volume has to offer is that it will never reach those unfortunate souls who need it most. Those folks who never read books, and who do not profit by their association with those who do, will be the ones who need the elementary training in matrimonial harmony contained in these pages. But how will they get this training? The book contains very little that will add to the store of common sense of folks who are readers, and who are wide-awake to the happenings in the world about them. It is hard to believe that in the latter group, one would find a person whose naivety would prompt him, upon facing some serious trouble, to take down *Harmony in Marriage* from his library shelf, and turn to page 113 and offer up the prayer which is so neatly written out there for that specific purpose.

OUR SEX LIFE. *A Guide and Counsellor for Everyone.*

By Fritz Kahn. Translated from the German by George Rosen. Alfred A. Knopf, New York. $6.00. 9½ x 6⅜; xxxviii + 459 + 29 plates; 1939.

In 735 numbered paragraphs the author gives information and advice on sex anatomy and function, sex hygiene, and sex behavior, beginning with the cell and ending with the solution of the sex problem (paragraph 725 tells us that the sex problem is unsolved, but not incapable of solution). Although the author at times waxes a little too poetic, the book contains more sense and fundamental information than many of the *vade mecums* of the sex life now on the market. It is interesting, however, to note paragraph 266 which is opposed to the newer theories: "The capability of the woman to conceive varies during the month,. . . but there are no 'safe' days. The sperm cell can live for days, even for weeks, within the sex apparatus and await the arrival of a new egg there."

This English translation, already well-known in the original under the title *Unser Geschlechtsleben*, should be welcome.

GESCHLECHT UND GESCHLECHTSBESTIMMUNG IM TIER-UND PFLANZENREICH. *Sammlung Göschen, Band 1127.*

By Max Hartmann. Walter de Gruyter and Co., Berlin. RM. 1.62. 6¼ x 4½; 110; 1939.

This small volume of the *Göschen* series was designed as an introductory text, for the interested layman as well as for the student, of sex organs and sex determination in plants and animals. Naturally, in a book limited to this size, not all aspects of the subject are included, and for the most part discussion of the secondary sex characters has been omitted. It is, however, accurate and authoritative and should serve the purpose for which it was intended. It is illustrated, and a glossary of terms and an index have been provided.

BIOMETRY

RESEARCH AND STATISTICAL METHODOLOGY. *Books and Reviews 1933–1938.*

Edited by Oscar K. Buros. Rutgers University Press, New Brunswick, N. J. $1.25. 9¼ x 6¼; vi + 100; 1938.

Some men *write* books, and some write book-reviews. Then, some men *collect* books, while some collect bibliographies and reviews. Rare, however, is the man who *publishes* his collection of book-reviews. The editor of the above volume has done just that. Agreeing, with Harold Hotelling, that a revolution has taken place in the field of statistics, and believing that the modern developments should be made more accessible in order that the use of older, less efficient, and incorrect methods of statistical analysis may not be unduly prolonged, Buros has published evaluative excerpts from selected critical reviews of books on statistical and research methodology. The present catalogue pertains to works published during the 1933-through-1938 interval. Similar collections may be published annually hereafter.

LEHRBUCH DER MATHEMATIK *zum Selbstunterricht und für Studierende der Naturwissenschaften und der Technik. Eine Einführung in die Differential- und Integralrechnung und in die analytische Geometrie. Siebente Auflage.*

By Georg Scheffers. Walter de Gruyter and Co., Berlin. RM. 15. 9⅛ x 6⅛; viii + 743; 1938.

This is the seventh edition of a well-known textbook. The author is himself an engineer and prepared the book especially for self-instruction and for the use of students in natural and technical sciences. Numerous examples in analytic geometry, and differential and integral calculus are given from a more practical point of view. The book has found many readers among students and teachers in Germany because it gives not only formulas suitable for the professional mathematician but also a relatively broad treatment in all the chapters. There is a very good chapter on the law of organic growth and exponential functions. As is usual in general text-books of this kind, the theory of probability is hardly touched upon.

STATISTICAL TECHNIQUE IN AGRICULTURAL RESEARCH. *A Simple Exposition of Practice and Procedure in Biometry.*

By D. D. Paterson. McGraw-Hill Book Co., New York and London. $3.00. 9 x 6; ix + 263; 1939.

Here is more evidence to indicate that the biologist of the future, no matter in what field his interests may lie, will be plagued by mathematical techniques. For accurate and meaningful interpretations of agricultural experimentation a statistical analysis is indispensable. The author demonstrates the various methods applicable to field experimentation. The statistical techniques employed are mostly those used when only a small number of variables are taken into consideration. An attempt has been made to render the presentation as reasonable as possible for the nonmathematically inclined research worker.

SIMPLIFIED STATISTICS.

By Leonard J. Holman. Sir Isaac Pitman and Sons, London. 3s. 6d. net. 7¼ x 4¾; xii + 142; 1938.

This gem of a book introduces the concepts of statistics almost without recourse to algebra. It is not an exposition of statistical theory, nor yet of statistical practice; it does not explain the underlying logic of statistics, nor does it provide ready-made the formulae with which the computer may work miracles. On the contrary, the aim is simply to set forth those basic statistical concepts which are common to natural science, commerce, and everyday life, and which should be a part of the general education of everyone. The book fulfills this aim in a most attractive manner.

PRINCIPLES OF THE THEORY OF PROBABILITY. *International Encyclopedia of Unified Science. Volume 1, Number 6.*

By Ernest Nagel. University of Chicago Press, Chicago. $1.00. 9½ x 6¾; vii + 80; 1939 (paper).

In this number Nagel discusses some of the logical bases of the calculus of probability. A brief historical survey introduces the subject and it is followed by an enunciation of the fundamental elementary theorems. The remainder of the monograph is devoted to critical review of the philosophy underlying the definition of probability and the frequency and non-frequency interpretations of probability calculus. For those not acquainted with the language and viewpoints of the student of logic, symbolic logic particularly, there are many statements which may appear rather unusual and difficult to understand.

COLLECTION AND PRESENTATION OF STATISTICAL DATA IN PSYCHOLOGY AND EDUCATION.

By Martin F. Fritz. Prentice-Hall, Inc., New York. 65 cents. 8 x 5½; vi + 58; 1939 (paper).

Written for the beginner, this small manual gives in a very simplified form some of the procedures in the collection, tabulation and graphic presentation of statistical materials. Tables and graphs illustrate the work, and questions for discussion, a list of useful books on statistics, and an index have been added.

PSYCHOLOGY AND BEHAVIOR

THE MECHANISM OF THOUGHT, IMAGERY, AND HALLUCINATION.

By Joshua Rosett. Columbia University Press, Morningside Heights, N.Y. $3.00. 10 x 7; x + 289; 1939.

This is a highly technical book. It is one of the results of the natural reaction of human intelligence to the chaos to which the metaphysicians of the 19th century had reduced psychology.

The premise on which the author builds his thesis is the Law of Evolution and Dissolution as defined by Herbert Spencer. The meaning of this law can best be illustrated by a quotation from the introduction: "Reason and judgment are recently acquired nerve functions, in the course of an individual's lifetime. In poisoning by alcohol, these functions are the first to succumb and they are the last to appear during recovery from the action of poison. On the other hand, respiration is phylogenetically a very old function; it is the last to be affected by the action of the poison and the first to recover."

The savants of past generations would have explained this result without recourse to Spencer's law. They would have attributed the differential disappearance and reappearance of reason and respiration, not to differences in phylogenetic age, but to differences in fundamental nature. Reason, they would have pointed out, is an activity of the mind and respiration one of the body, and to them such a statement as that embodied in the above quotation would have been considered evidence of loose thinking. But in reality it is not so, for Rosset considers reason and judgment to be just as physiological as respiration. The word "mind" does not occur in his book except in the historical introduction. In this he breaks completely with the classical tradition of William James and his satellites.

The book is largely a discussion of empirical evidence to show that not only in alcoholic poisoning but in all other forms of suspended cerebration, such as encephalitis or other diseases, physical injury to the brain, epileptic seizure, or even normal sleep, the phylogenetically younger activities are always the first to be lost and the last to be recovered. The chapter on sleep is the longest and perhaps the most informative in the book. The mental activities suspended during sleep are classified under the headings "Thought," "Imagery," and "Hallucination." Needless to say the technical meanings of these terms differ somewhat from the connotations which they carry in popular conversation. A hallucination is generally considered a positive entity —i.e., it is something people have. But according to Rosett it is an essential component of normal thought which appears only when the subject lacks a phylogenetically younger entity essential to

normal cerebration. But thought, imagery, and hallucination are not mutually exclusive classes—rather they are successive grades, and in the process of falling asleep and awakening the transition from one to the other is gradual and insensible.

There is a very finely divided index which covers 17 pages. A peculiar feature of the book is that among the 227 bibliographic references only 14, or less than 7 percent are to other works by the same author.

MENTAL DISORDERS IN URBAN AREAS. *An Ecological Study of Schizophrenia and Other Psychoses.*

By Robert E. L. Faris and H. Warren Dunham. University of Chicago Press, Chicago. $2.50. 7½ x 5½; xxxviii + 270; 1939.

This book presents a study of mental disorders by means of an ecological technique, that is, by an investigation of the "spatial character of the relations between persons who have different kinds of mental breakdowns." The site of the study is Chicago which is subdivided by the authors into nine areas distinguished by the predominance of a certain type of dwelling, as tenement and rooming houses, apartment houses (native-born, foreign-born, Negro), single homes, etc. Insanity rates for these different areas were then determined, based on first admissions to the Cook County Psychopathic Hospital for the two years 1930–1931. It is found that the highest rate occurs in the central business district, and that there is a steady decline in rates in travelling from the center of the city where the lower type of housing is found to the periphery where higher grade dwellings predominate. The different psychoses were next studied individually. The distribution pattern for schizophrenia, like that for insanity as a whole, is characterized by a high concentration of cases at and near the center of the city, with declining rates as the periphery is approached. Manic-depressive cases, on the other hand, show a definite tendency to come from a higher cultural and economic level. Alcoholism and drug addiction show a pattern similar to that found for schizophrenia.

The authors have assembled an impressive and interesting array of material which is demonstrated graphically by a series of shaded outline maps of the Chicago area. A corroboratory study of the city of Providence, Rhode Island, is also reported. Details of the data are presented in tabular form in an appendix. A selected bibliography is given and there is an index.

THE STARTLE PATTERN.

By Carney Landis and William A. Hunt, with a Chapter by Hans Strauss. Farrar and Rinehart, New York. $2.50. 8 x 5⅜; x + 168; 1939.

This book represents an attempt to study a basic, constant emotional response to a sudden emotional stimulus. Specifically, the startle response to the sound of a revolver shot was recorded by means of an ultra-speed moving picture camera, first for a group of normal adults, then for infants and children and for various types of psychiatric patients. It was found possible to define a characteristic, constant normal response, consisting of blinking of the eyes and general flexion of the body, completed in less than half a second and not affected by muscle tension, posture, or inhibition. This startle response is compared with the Moro response in infants and the conclusion reached that it is the more basic response, finally superseding the Moro. In schizophrenic patients the response was stronger than normal in the catatonic type, normal in other types. However, the immediate secondary behavior of the schizophrenic patients showed more flight and fear responses than normal. In the feebleminded the response was found to be quantitatively stronger, but the pattern was qualitatively normal. The most striking deviation from the normal pattern was found in epilepsy where the response was weak, with the lid reflex frequently absent. Of particular interest is the observation that in hypnosis this apparently basic response can be suppressed.

This ingenious study has been carefully

done and is well presented. The results seem important, particularly in suggesting a new and objective type of approach to the little explored problems of affective behavior in human beings. There is a bibliography of 79 titles and an index.

LIFE WITHOUT FEAR.

By Peter Fletcher. Foreword by Percy L. Backus. E. P. Dutton and Co., New York. $1.00. 7½ x 5¼; vii + 111; 1939.

This small volume is dedicated to the thousands of unfortunates throughout the world who live and struggle under some form of personal fear, and is written in the hope that it may lead them to some measure of security, peace of mind, and general satisfaction with life. The author's analysis of the many psychoses resulting from fear and his suggested cures are well expressed in his own words,

> . . . although I have been discussing what may properly be called psychological conditions, I have thought of them always as the manifestations of spiritual attitudes to life and its responsibilities; and wherever I have suggested any remedial measures, my emphasis has always been upon the necessity for a religious approach to the problem.

Fletcher's philosophy of life is shown by the following excerpts:

> Life is in truth a spiritual adventure, and its true meaning is only to be discerned by those eager souls who are willing to forget themselves in the dangerous business of serving the purposes of God. . . . the way to peace for us will be by unflinching honesty with ourselves concerning ourselves, and a resolve to forget ourselves in the service of others; accepting the situation in which we find ourselves, and determining to make the best of it, not by any mental dodgery, but by courageous, resolute activity within the measure of our real capacities and in the reliance of God.

Our first impression is that Mr. Fletcher is a bit optimistic about man resolving to forget himself in the service of others (man being innately a selfish, non-social, and far-from-altruistic creature).

FRUSTRATION AND AGGRESSION.

By John Dollard, Leonard W. Dobb, Neal E. Miller, O. H. Mowrer, Robert R. Sears, in collaboration with Clellan S. Ford, Carl I. Hovland and Richard T. Sollenberger. Yale University Press, New Haven; Oxford University Press, London. $2.00. 9 x 6; viii + 209; 1939.

In this publication from the Institute of Human Relations of Yale University, an attempt is made to reduce the relationship between frustration and aggression in human individual and social behavior to more or less predictable terms. Assuming as their basic postulate that aggression always follows frustration, the authors consider various corollary aspects of this relationship, such as degree of frustration, inhibition and displacement of aggression and the effects of aggression on the aggressor. The principles which emerge are discussed in subsequent chapters in relation to frustrations in American socialization and the regulations of aggression, and to adolescence, the period of intensified socialization. One chapter, devoted to criminality, contains a necessarily brief but excellent summary of pertinent present-day work. A rather speculative chapter considers frustrations under democratic, fascistic and communistic societies, and the gratifications which each guarantees. In the final chapter, frustrations in a primitive society are described. The style of the book is academic and the handling of the material somewhat cumbersome and a trifle dull, defects perhaps inherent in multiple authorship. There is a bibliography of 189 titles and an index.

THEORIES OF SENSATION.

By A. F. Rawdon-Smith. The University Press, Cambridge; The Macmillan Co., Co., New York. $2.75. 8½ x 5½; xiii + 137; 1938.

The special senses of man are of incalculable value to him in adjusting himself to his environment, yet the exact knowledge of how these senses operate has remained meagre, and confined almost entirely to the realm of speculation. The author has gathered into this book all the available experimental data pertinent to vision and audition, and has discussed them in relation to the latest theories of sensation. Section I presents, in some detail, a discussion on the anatomy of the

eye together with the theoretical mechanisms that account for the eye's discrimination of intensity of light, color, and distance of objects. The section on hearing deals with the anatomy of the ear in relation to the perception of pitch and intensity of tone.

In many instances there are conflicting views as to the value of a particular theory, and in these cases, the author presents both sides of the question, together with a statement of his own opinion, based on the results of recent experimentation.

An extensive bibliography and a complete index are valuable assets of this fine volume.

BIOGRAPHIES OF CHILD DEVELOPMENT. *The Mental Growth Careers of Eighty-Four Infants and Children. A Ten-Year Study from the Clinic of Child Development at Yale University.*

Part One by Arnold Gesell. Part Two by Catherine S. Amatruda, Burton M. Castner and Helen Thompson. Paul B. Hoeber, Medical Book Department of Harper and Bros., New York and London. $3.75. 9¼ x 6¼; xvii + 328; 1939.

The authors of this study have traced the mental-growth careers of eighty-four infants and children over a period of ten or more years. In presenting these cases from their huge clinical records which run well into the thousands, the authors have mainly selected those cases which expose the difficulties and pitfalls of clinical diagnosis and prognosis and which are especially significant in clinical application and developmental psychology. The eighty-four mental-growth cases are presented not as brief impersonal case histories, but as individual biographic sketches. The authors stress throughout the book the possibilities of predicting mental-growth trends and the difficulties incurred in such predictions in atypical cases.

Part I deals with a review and follow-up of those cases which were published in a previous volume; Part II deals mainly with cases involving social and guidance problems.

A list of basic manuals and source books is given for readers and students not familiar with the clinical methods used in these developmental examinations.

PSYCHE UND LEISTUNG DER TIERE.

By Werner Fischel. Walter de Gruyter und Co., Berlin. RM. 15. 9 x 6⅛; vi + 290; 1938.

This is an exposition of animal psychology on the basis of the present state of scientific research by the director of the research institute of the zoological gardens in Münster. All the incident problems are thoroughly discussed and possibilities set forth for further experimental investigations. Inasmuch as an accurate knowledge of animal psychology is of importance for a proper conception of the psychical factors in man, the book will prove to be of great value not only to the biologist and zoologist, but likewise to the psychologist, psychiatrist, philosopher and educator, whether theoretical investigator or practitioner.

There are 105 illustrations, an extensive bibliography, and indices of topics and names.

LECTURE DEMONSTRATIONS FOR GENERAL PSYCHOLOGY.

By Norma V. Scheidemann. University of Chicago Press, Chicago. $2.50. 7½ x 5⅛; x + 241; 1939.

This book represents a compilation from the psychological literature of 60 tests and demonstrations used by recognized psychology teachers in the classroom to elucidate points covered in their lectures. Each demonstration is described concisely with regard to purpose, material, procedure, and points of interest to the class. A brief summary of previous experience with, and conclusions from, each demonstration is given. The selection of demonstrations seems excellent, and the book should be of practical interest to all teachers of psychology.

THE TROUBLED MIND. *A General Account of the Human Mind, and Its Disorders and Their Remedies.*

By Harry Roberts. With chapters on the Insanities by Margaret N. Jackson. E. P. Dutton Co., New York. $2.00. 7½ x 5¼; [4] + 284; 1939.

This discussion of mental functions and of present-day viewpoints in psychology and psychiatry is designed for the layman and is to be recommended as a sensible, accurate and thoroughly pleasant piece of work. The first half of the book deals with normal psychobiological mechanisms, the second half with a brief discussion of the most common neuroses and psychoses. Chapters are devoted to the types of treatment available, and to existing legalities for protecting the mentally ill. The information covered is that with which every intelligent layman should be familiar, and this book offers a reliable source. There is a brief index.

THE NINETEEN THIRTY EIGHT MENTAL MEASUREMENTS YEARBOOK OF THE SCHOOL OF EDUCATION OF RUTGERS UNIVERSITY. *Edited by Oscar K. Buros. Rutgers University Press, New Brunswick, N. J.* $3.00. 9¼ x 6⅛; xiv + 415; 1938.

The *Mental Measurements Yearbook* is a comprehensive and systematic review and criticism of mental tests and books on mental tests. The book is frankly critical and starts with the assumption that "...ninety out of every hundred tests published in the United States should be withdrawn because they have never been satisfactorily validated and standardized." The value of the book is greatly enhanced by the cooperative reviewing of over a hundred specialists in the field of testing. This *Yearbook* is a "must have" for all those operating in the field of mental testing.

DE OMNIBUS REBUS ET QUIBUSDEM ALIIS

WHENCE? WHITHER? WHY? *A New Philosophy Based on the Physical Sciences. By Augusta Gaskell. Introduction by F. K. Richtmyer. G. P. Putnam's Sons, New York.* $2.50. 8½ x 5¾; 312; 1939.

The late Augusta Gaskell was a remarkable woman. To an original, clear, and vigorous mind she added an indomitable energy that was never daunted by difficulties. In her lifetime she accomplished an amount of work that was literally prodigious. Perceiving that the development of her ideas required a sound knowledge of a wide range of science in its most recondite branches she proceeded, by the simple process of hard, patient labor, to get that knowledge. Short cuts never interested her. Nor did anything intellectually cheap, smart or dishonest. No personal sacrifice was too great if it would help in the steady progression of her work.

The major objective of Mrs. Gaskell's life was to produce two books—*What is Life?* and *Whence? Whither? Why?* The present volume, essentially finished just before the onset of her last illness, marks the accomplishment of this objective. It will be noted that the titles of both books are *questions*. This is not accidental. Mrs. Gaskell was as far removed as it is possible to conceive from either the dogmatist or the propagandist. She was just curious to find truth. The present volume sets forth the conclusions she had tentatively reached about the oldest and greatest of philosophical problems—the meaning of human existence. We agree with, and cannot improve upon, the estimate of the book that Prof. Richtmyer gives in his *Introduction*.

> Granted the correctness of her statements of factual knowledge, there remains the evaluation of her philosophical arguments and conclusion. From the very nature of the case, each reader must make this evaluation for himself. The critical, thinking, yet sincere, reader will of course find much to criticise. He may think occasionally that the evidence upon which arguments are based is inadequate. He may disagree here and there with statements and conclusions; perhaps with now and then a whole chapter. Those philosophers, professional or amateur, secular or religious, who have already formulated opinions and conclusions which approach the subjectively dogmatic, probably will not only be unconvinced but, following natural human traits, will set out to prove that Mrs. Gaskell is wrong. Some may think that her efforts are not worth even that attention.
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> However, the reader who approaches Mrs. Gaskell's book with an open mind will find it interesting, stimulating and thought-provoking—which should be the main objectives of any book of this kind.

A HISTORY OF SCIENCE, TECHNOLOGY, AND PHILOSOPHY IN THE EIGHTEENTH CENTURY.

By A. Wolf. The Macmillan Co., New York. $8.00. 9½ x 6; 814; 1939.

This is a scholarly piece of work. The author had already established a reputation with a similar book dealing with the two preceding centuries, and the present work is well worthy of its predecessor. It is a treatise of encyclopedic proportions covering not only science *sensu lato*, but philosophy as well. The discussion of the latter falls into place quite naturally after that of the social sciences, which, since their precepts are not amenable to laboratory experimentation seem more closely affiliated to philosophy than to the physical and biological sciences, and consequently form an effective link between the two.

Prof. Wolf seems to be equally at home in either science or philosophy, and his writing exhibits none of the frictional jealousy that sometimes appears when a writer attempts to cover both fields. He has accomplished a highly significant account of human learning in the 18th century. The illustrations are splendid, the index detailed and adequate, and it is to be hoped that companion volumes dealing with the later centuries may soon come from the same pen.

PHOTOGRAPHY, ITS PRINCIPLES AND PRACTICE. *A Manual of the Theory and Practice of Photography. Third Edition.*

By C. B. Neblette. D. Van Nostrand Co., New York. $6.50. 9 x 6; xi + 590; 1938.

Photography is intended as a textbook on the subject and assumes that the reader has a knowledge of chemistry and physics. It presents in descriptive and mathematical terms the qualities associated with different types of lenses, and in conjunction the exposure which must be allowed in each case. Likewise the author deals with the chemical processes involved in preparing emulsions, developing, and fixing. Aside from the purely technical aspects of photography, the amateur can learn much from these pages. An interesting history of the subject is given in the opening chapter. Practical methods are presented for developing, printing, enlarging, mounting, and retouching. A particularly useful chapter is that on negative defects, teaching the photographer wherein his errors lie. It is a very complete manual, well indexed, and containing extensive references.

BIOLOGY AND CHRISTIAN BELIEF.

By William O. Greenwood. Foreword by Theodore Savory. The Macmillan Co., New York. $1.75. 7¾ x 5¼; 192; 1939.

The author, in revealing the natural wonders of the universe, shows life to be a "web on the loom of time," God being the Divine Weaver. But his arguments have the stability of a spiderweb woven to a swinging barroom door. Talking first of physical things, Dr. Greenwood mentions the size and weight of atoms, but a few pages later says of them, "Waves and disturbances are all we find and,. . .on the very threshold of our inquiry, while we attempt to extract some meaning from the very elementals, we are met with the arresting suggestion that, lying at the heart of the apparently material, is the presence of what we must call spiritual." This book like many others of its ilk, uses the argument that since science cannot demonstrate how the universe originated, the only thing that offers any rationality is a creative act of a master mind.

WHAT'S TO FOLLOW? *A List of Books on Cookery in the Oxford City Libraries.*

Oxford City Libraries, Oxford. Foreword by Mrs. C. F. Leyel. 7¼ x 5; 15; 1939 (paper).

This little handbook giving the "list of books on cookery in the Oxford [England] City Libraries" we find entertaining. In the foreword Mrs. Leyel recalls the maxim of George Birmingham's Irish curate, who held that it doesn't matter what you feed a child on "as long as you give it enough of whatever it is you do give it." The books (153 in number) are listed under various headings. A number of them are known to Americans but many, of course, are not. Added

interest is given by the inclusion of a few choice local recipes: e.g., an eighteenth-century trifle "frequently used in Oxford," Oxford sausages, Banbury cakes, wassail "a very old cup which used to be drunk at Jesus College, Oxford" and an old Burford recipe for dandelion wine.

SCIENCE IN AFRICA. *A Review of Scientific Research Relating to Tropical and Southern Africa. Issued by the Committee of the African Research Survey under the Auspices of the Royal Institute of International Affairs. By E. B. Worthington. Oxford University Press, London, New York and Toronto.* $4.00. 8½ x 5½; xiii + 746 + 7 plates + 2 folding maps; 1938.

This volume is a report of the African Research Survey. Its eighteen chapters cover practically all the geological and biological sciences though in some instances rather inadequately; e.g. the pseudohaline fauna of Lake Tanganyika, the oldest and second deepest lake in the world, is dismissed in a single sentence. No mention is made of the pioneers Burton, Speke, Bourguignat, or Edgar A. Smith, and Livingstone is mentioned only once.

The index comprises 56 pages, the bibliography 65, and the acknowledgements 11, so that despite the lack of information in the specific instances mentioned above the book is nevertheless full of essential material concerning African science.

EDUCATIONAL FOUNDATIONS. *By the late J. Lionel Tayler. Edited, with an Introduction by H. Salmon. J. W. Sparks, London.* 3s. 8½ x 5⅝; 176; 1939.

These posthumously published essays of the late Lionel Tayler deal, from a broad point of view, with the relations between biology and education. They are edited by H. Salmon who added an introductory chapter on social education. The essays cover a great variety of matter worth reading but difficult to review briefly, such as the biological interpretation of life, the biological ideal of education, educational foundations as a study of motives, adolescence and the birth of ideals, education and the national welfare as a scheme for the stages of life. The manifold subjects broached in the different essays will probably find many interested readers among biologists and sociologists.

THE STORY OF A FACE. *By Hillary G. Bailey. Camera Craft Publishing Co., San Francisco.* $2.50. 9½ x 6¾; 127; 1938.

CHAMPLIN ON FINE GRAIN. *By Harry Champlin. Ibid.* $2.00. 7¾ x 5½; 154; 1938.

MODERN PORTRAITURE. *By Stanley R. Jordan. Ibid.* $3.00. 8½ x 6⅛; 199; 1938.

PRINT FINISHING. *By William Mortensen. Ibid.* $2.50. 9½ x 6¾; 128; 1938.

SNOW AND ICE PHOTOGRAPHY. *By H. W. Wagner. Ibid.* $1.00. 7 x 5¼; 96; 1938 (paper).

COMMERCIAL PHOTOGRAPHY WITH THE MINIATURE CAMERA. *By C. A. Goldner. Ibid.* $1.00. 7½ x 5¼; 95; 1939 (paper).